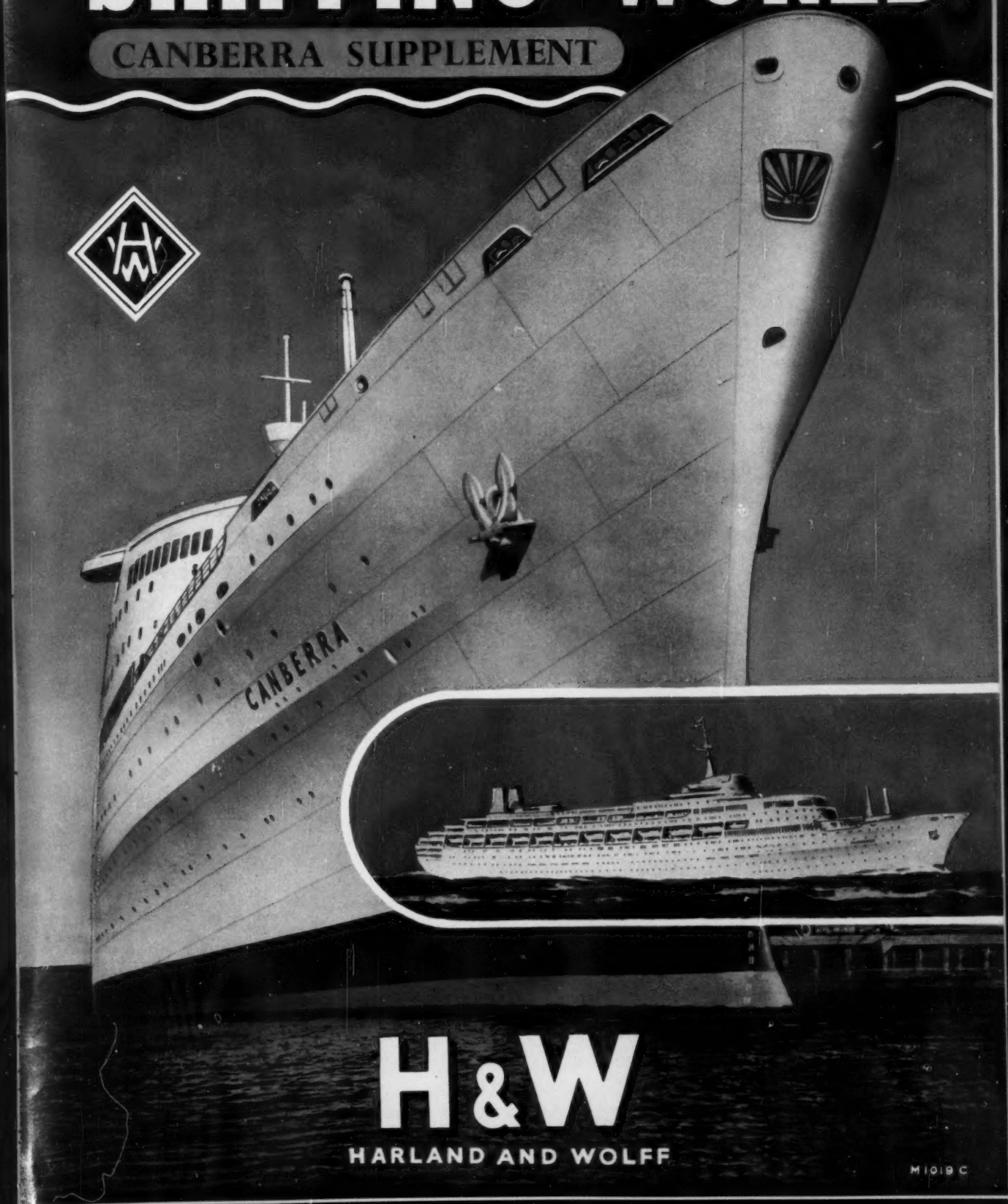
SHIPPING WORLD

CANBERRA SUPPLEMENT



H&W

HARLAND AND WOLFF

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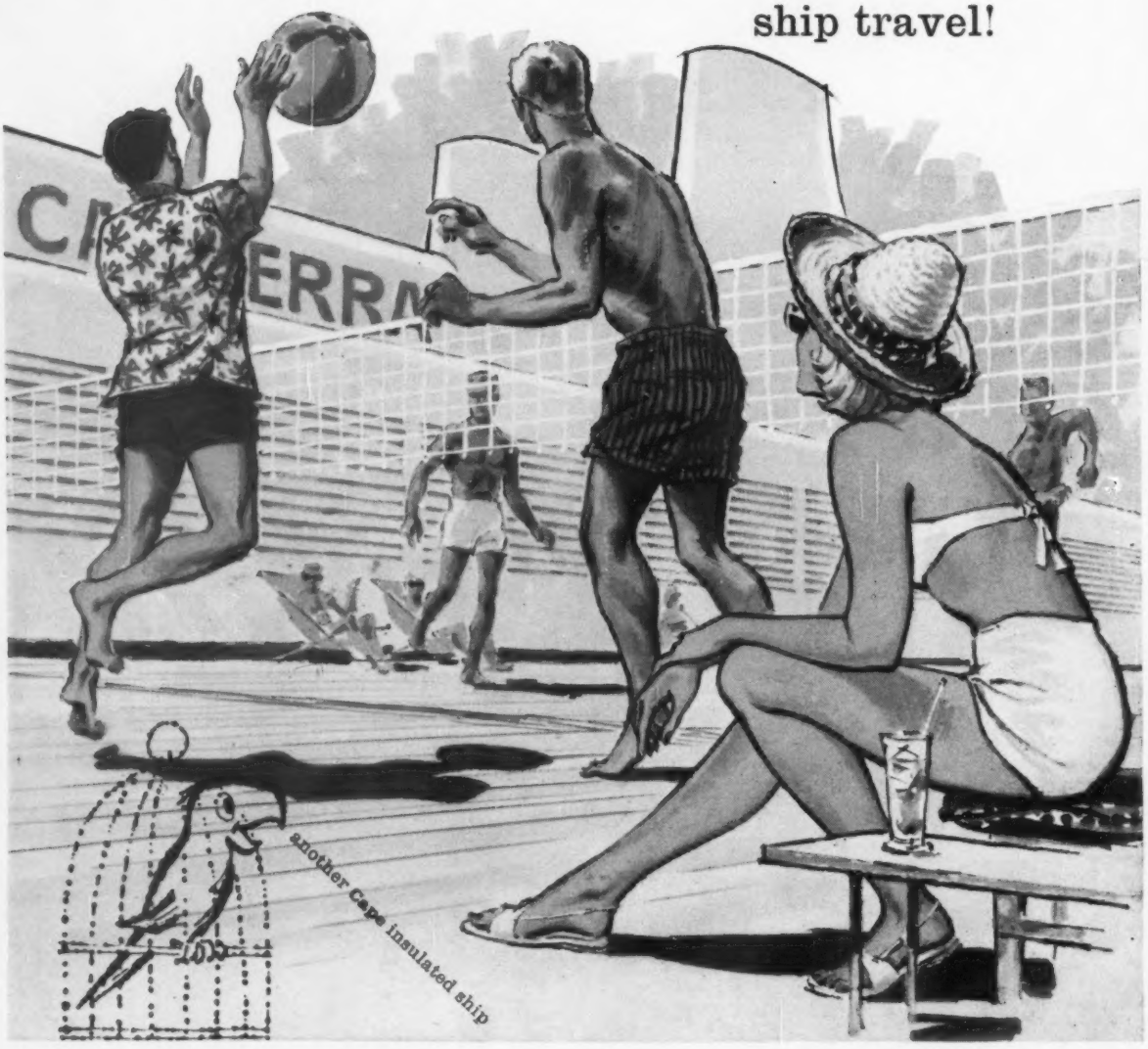
BELFAST GLASGOW LONDON LIVERPOOL SOUTHAMPTON

Setting completely new standards of speed, safety and passenger comfort and service, Canberra is a symbol of creative achievement. Throughout her construction, only the finest and most advanced materials have been used. Caposite amosite asbestos and Rocksil rock wool were both used extensively in two of the largest thermal insulation contracts in the ship. The work was carried out by Andersons Insulation Co. Ltd., and included the contracts for the 'A' Class Fire Insulation in the steel and aluminium structures, and the whole of the engine room and machinery insulation. This embraces such details as the crowns of the boiler room and engine room spaces, the majority of the entrance halls, stair-wells and lift-shafts; and the insulation of the boilers, engines, machinery, funnel uptakes and forced-draught fans.

welcome to the new age of luxury ship travel!

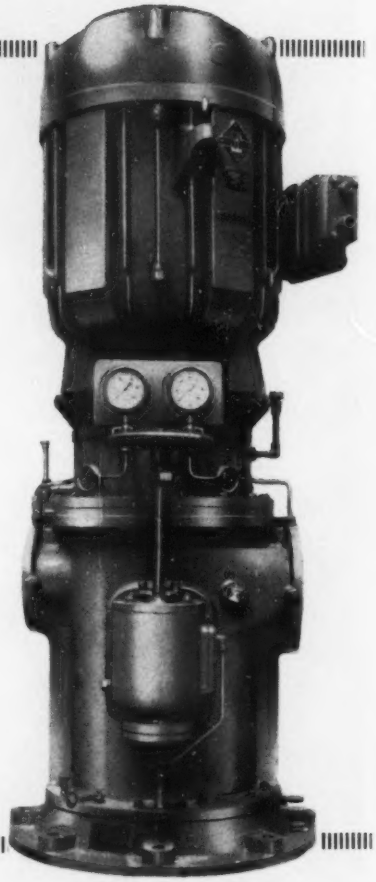


Cape Insulation & ASBESTOS PRODUCTS LIMITED

(A subsidiary of The Cape Asbestos Company) 114 & 116 PARK STREET, LONDON, W.1. Telephone: GROsvenor 6022

TA5394

Stothert & Pitt pumps and deck machinery for s.s. "Canberra"



PUMPS

The ballast problems created by positioning the machinery aft in the new P & O Liner s.s. 'Canberra' placed greater importance than usual on the choice of pumps. To deal with oily ballast and for stripping, it was decided to install Stothert & Pitt screw pumps.

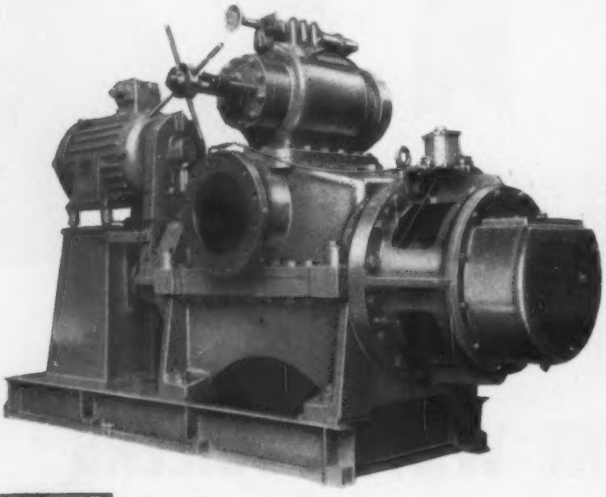
For oily ballast Stothert & Pitt built horizontal positive acting screw displacement pumps with external bearings. Of all round clearance design and fully self priming, each pump has a capacity of 250 tons per hour.

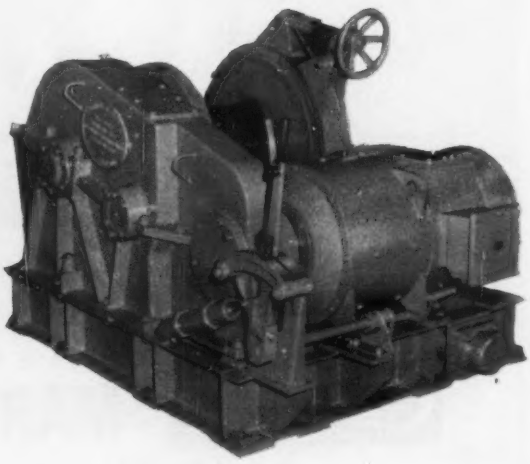
For stripping the 'Canberra' uses S & P vertical screw displacement pumps, also of external bearing design; each is direct coupled to an electric motor and has a capacity of 75 tons per hour.

Both types are fitted with mechanical seals.

DECK MACHINERY

We also supplied for the s.s. 'Canberra' two 50 b.h.p. 'Pitt-Scott' Johnson type automatic mooring winches. These are fitted on the starboard side, one forward and the other aft, and hold the ship against a set tension on the mooring wire, heaving-in and paying-out as the pull on the wire varies.





S&P LIMITED

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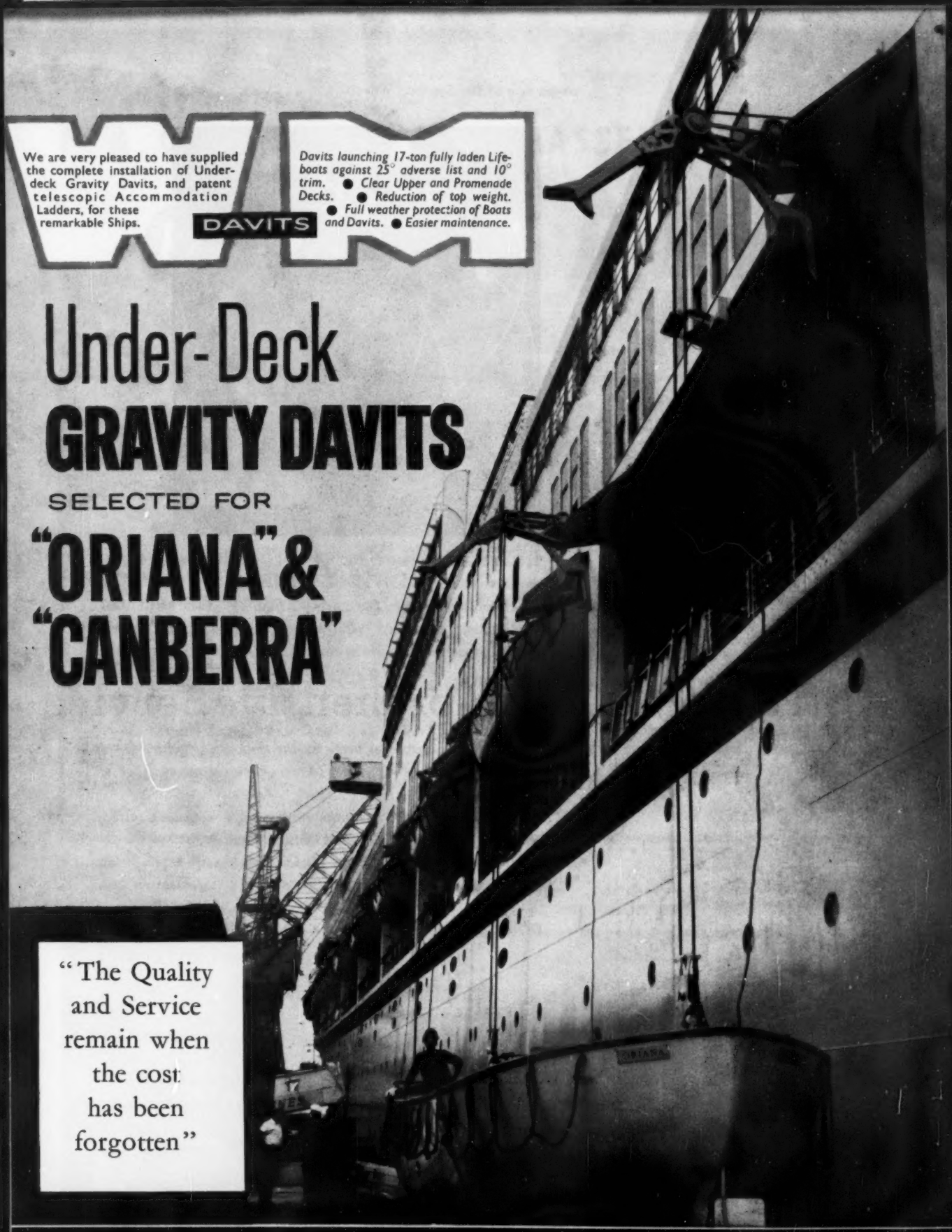

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Davits launching 17-ton fully laden Lifeboats against 25° adverse list and 10° trim. ● Clear Upper and Promenade Decks. ● Reduction of top weight. ● Full weather protection of Boats and Davits. ● Easier maintenance.

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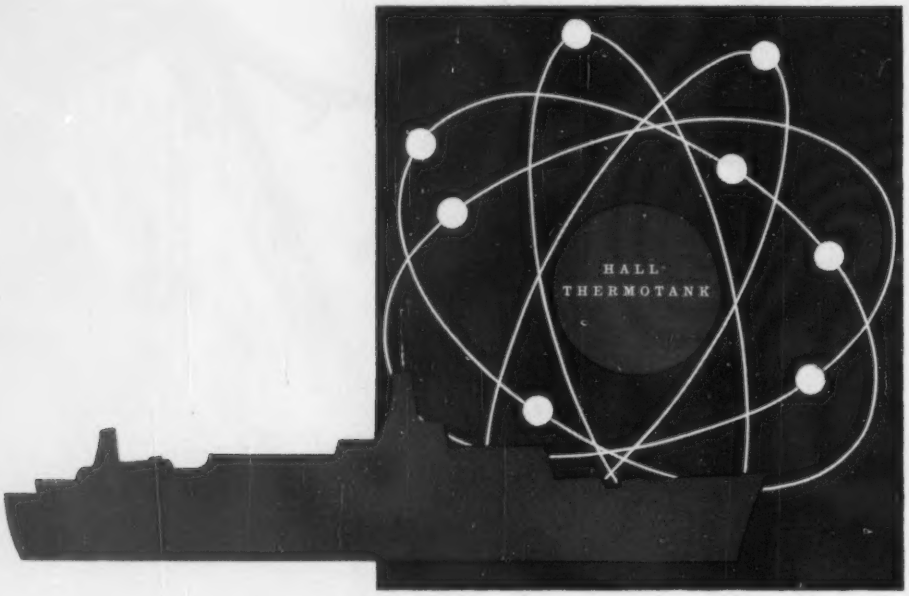

THE HALL-THERMOTANK organisation provides a comprehensive range of highly specialised services. These include air conditioning systems, refrigeration plant, lifts and escalators, ventilating fans and equipment, lighting installations, acoustic research and sound control, modern plastics products.

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Nine specialist companies make up the complete structure of the Hall-Thermotank Group. They are ready to serve, together or individually.

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FOR THE P & O LINER 'CANBERRA'— the world's most modern passenger vessel

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786

P & O–ORIENT LINES PASSENGER LINER

CANBERRA

Supplement to THE SHIPPING WORLD, 31 MAY 1961

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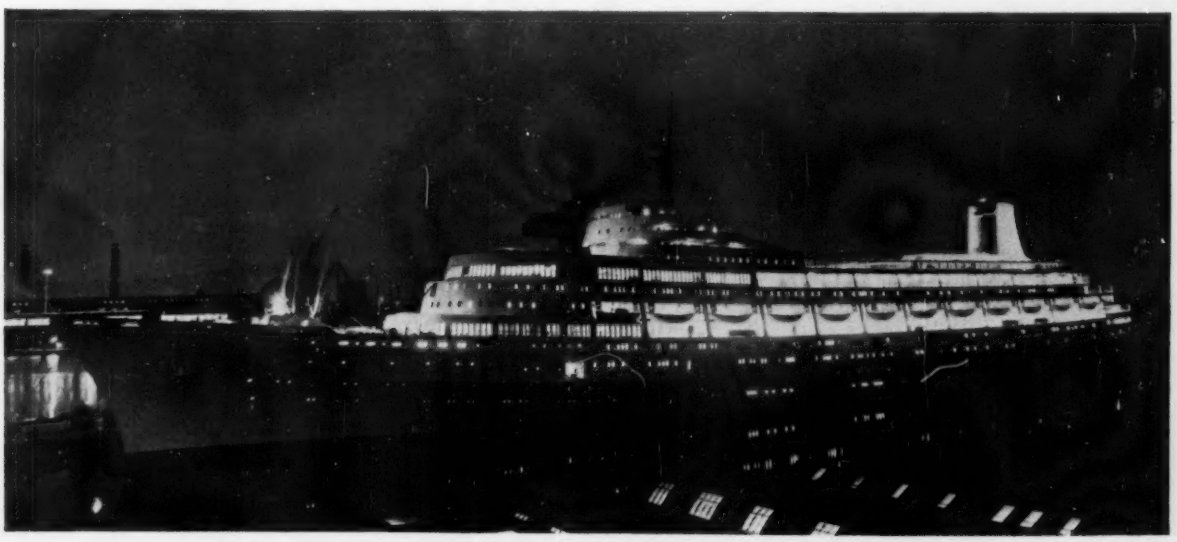
A night view of the "Canberra" at the fitting-out berth, shortly before she left Belfast



Sir Donald Anderson

TRAVEL BY SEA

By SIR DONALD ANDERSON

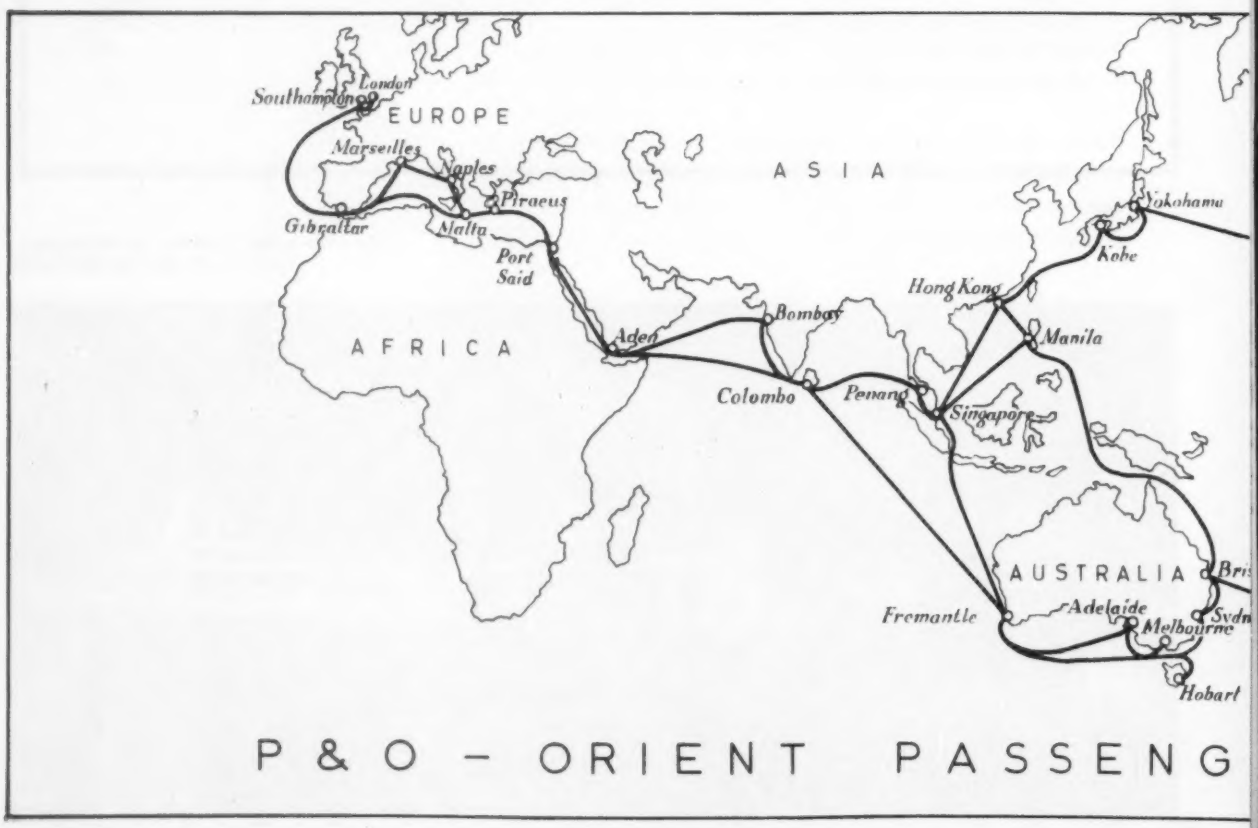
Chairman of the P & O Steam Navigation Company

THE CAREER of the *Canberra* begins at a time when the world is agog with news of space travel, which has now become a reality for man. The two events provide a strange contrast. While the scientists are intent on hurtling man through space at incredible speeds to reach new worlds, shipowners continue to perfect a form of travel that has been known to our world almost since the time when man first inhabited it.

Yet the coming age of space travel, if it comes, will not mean the end of earthbound means of travel, any more than the high-speed jet aircraft means the demise of ocean ships. As long as vehicles, whatever form they take, are whizzing over our heads, out of sight or not, so long will the attractions of travelling unhurriedly and peacefully by sea become more evident.

Coming back to earth—and not all space travellers will be able to do that—we have to think of the more immediate future. Some of the prophets on travel evidently believe that the prospects for passenger shipping are uniformly dim. Over certain routes, and for certain route lengths, they are right. Travel habits, like everything else in the world, are changing, and many people think little more of using an airliner than they do a 'bus or train.

Tourism, although a rather ugly word, is one of the keys to the future of passenger ships. Gone are the days when people travelled in passenger ships mainly because they had no alternative. Today no one *has* to use a ship, and so we have to adjust our thinking and planning to this fact. The basic problem is how to bring out to the maximum the inherent attractions of sea travel. The linchpin in the answer to this teaser is,



of course, the ship itself; but there are other important factors to take into consideration, and you may have the best ship in the world and still not be able to fill her unless you have paid careful attention, not only to service on board, but to such things as routes, promotion, advertising, and so on. In short, commercial appreciation of all that is involved.

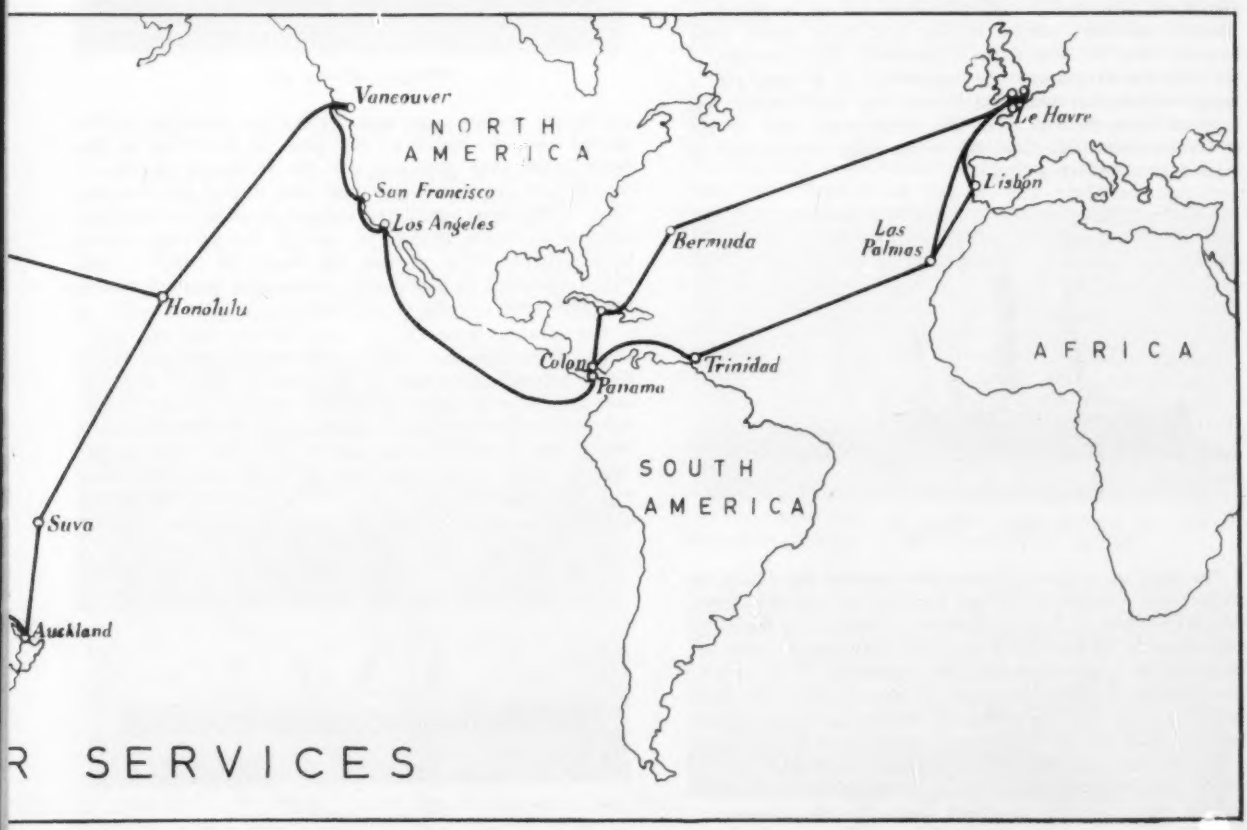
That is why the *Canberra* must be considered as only part of our attempt to find an answer to what is a very complex question. We take pride in the fact that we have been able to put two passenger liners of such importance as the *Canberra* and *Oriana* on the Australia run. But these liners were not conceived merely to provide a shuttlecock service between Britain and Australia. We came to realise long ago that Australia is more and more looking to the east as well as to the west.

Today, Australia's second-best customer—after the United Kingdom—is Japan. Next comes the U.S.A. And Australia's trade with Indonesia, Malaya, China, Canada, New Zealand—in fact, all the countries of the Pacific perimeter—is increasing. The Pacific, as far as Australia is concerned, is no longer a void, but a potentially vast reservoir of tourism, trade and commerce, which can be tapped if the pipelines are provided. We are helping to provide them.

Now we are moving with Australia into the Pacific, north and south. Since 1954 we have been developing new routes across the Pacific in a vast triangular system linking Australia with North America and Japan. We are breaking new ground, though we have to do a great deal more breaking yet. With passengers, then, we are doing a number of things; we are taking businessmen and emigrants from the United Kingdom to Australia and bringing back businessmen, students and tourists; we are taking businessmen and tourists from Australia to North America; and we are taking tourists from North America to the Far East, and in increasing numbers direct from the Pacific Coast to Europe.

The *Canberra* and *Oriana* are the first ships to be designed and built with an eye to what is needed in all these trades, for all types of passengers, and—to a very minor extent—for freight. The number of really modern new ships is never great, and the number of modern new ships which are intended to do something new is very small. The *Canberra* and *Oriana* are not only new—they are modern. Supported by our other modern liners, they are intended to do something new; and although they are strikingly different from each other, they are built to the same requirements and are intended for the same services.

This is the background against which we have made an investment of some £30mn in these two ships. We are a purely commercial British enterprise, with no support from the taxpayer, and our business now is to secure a return on the outlay. We believe we have made a good start, but plenty of hard work and ingenuity—and, I must add, some luck—will be needed before we can judge whether our assessment and our timing have both proved as right as we hope.



"Canberra" and the Queen's Island

By DENIS REBBECK

Dr Denis Rebbeck, deputy managing director of Harland & Wolff Ltd

THE QUEEN'S ISLAND has been well known for 90 years as the birthplace of many famous passenger liners. From every point of view this reputation is both well established and well earned, and looking through our records the other day I was reminded once again of the number of outstanding passenger vessels which Harland & Wolff have built. It all began with the White Star liner *Oceanic* in 1871, and stretches right up to the *Canberra*.

When *Oceanic* was completed she was regarded as a great step forward in passenger vessel construction. In all respects—in her hull, in her machinery and in her internal arrangements—she excelled any vessel afloat at that time. How easily and appropriately one could say just the same things about the *Canberra* today. In *Oceanic* the first-class accommodation was placed amidships, where it was well away from the noise and vibrations of the propeller. The saloon extended the full width of the vessel and thus had natural light on each side. A large smoking room amidships contrasted most favourably with the scanty accommodation provided in other vessels. Electric bells were fitted for the first time and the accommodation was lit by gas. The main propelling machinery consisted of inverted vertical direct-acting compound steam engines, and steam was provided by twelve oval boilers with a working pressure of 65 lb/sq in. The indicated horsepower was 2,000 (*Canberra's* is 85,000) with a daily coal consumption of 65 tons and the ship had a speed of 13½ knots, whereas *Canberra* will cross the oceans at a little more than twice that speed.

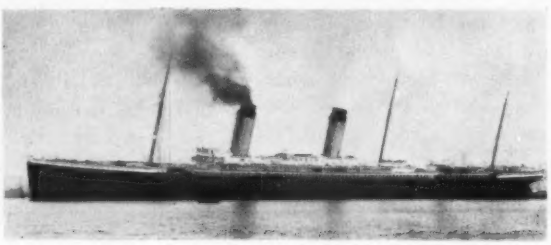
It has been said that Harland & Wolff won their laurels by building the many celebrated vessels which formed the White Star fleet. The first order for six large trans-Atlantic steamers placed in the year 1870 (these were *Oceanic* and her five sisters—*Canberra*, unfortunately, is an only child) marked the beginning of a long and a happy association with the White Star Line which was to continue unbroken until the 1930s when, due to the severe economic blizzard, the White Star Line ceased to exist as a separate entity.

1880 — "Rosetta"

The early records of the firm also contain the names of many other famous passenger shipping companies—both British and foreign. For the purpose of this article the most interesting is to be found in 1880 when the *Rosetta*—a three-masted screw-propelled iron schooner, 390ft long—was launched for the Peninsular & Oriental Steam Navigation Company, the beginning of another long connection between Harland & Wolff and a great shipowning firm.

The *Rosetta* was No 134 on Harland & Wolff's books, whereas *Canberra* is No 1621. The intervening numbers include many famous passenger liners like the *Germanic*, a single-screw four-masted iron barque, built in 1874, especially noteworthy not only because of her remarkably long and useful life, she being no less than 60 years old when wrecked in the Sea of Marmora as the Turkish-owned *Gulcemal*, but also because she was the last of the White Star liners to be built of iron.

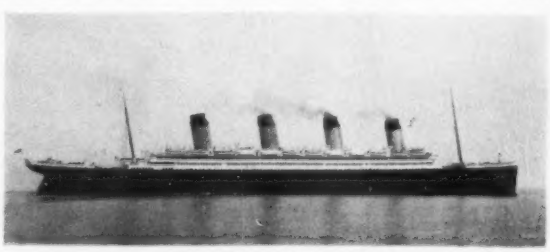
Just as *Canberra* is undoubtedly the crowning achievement of the Queen's Island so far in this the 20th century, so the greatest achievement of the Queen's Island in the



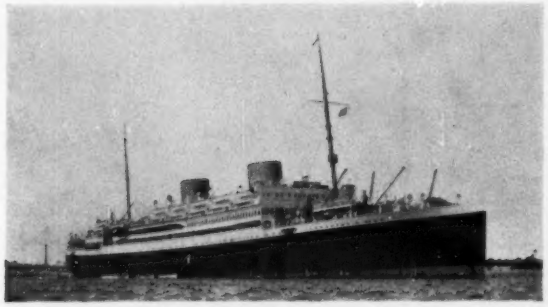
1899 — "Oceanic (2)"

nineteenth century was undoubtedly the building of the second *Oceanic*, hailed by the press of that time as the finest vessel ever produced and the crowning success of the century in naval architecture and marine engineering. This 17,000-tons vessel represented a most outstanding advance in steam propulsion, and it was perhaps fitting that, with her 685ft of steel, she should be the first ship which exceeded in length that remarkable product of the mid-19th century—the *Great Eastern*.

The closing years of the last century and the early years of the twentieth century saw many large passenger liners leaving the stocks at the Queen's Island and the demand for ever larger passenger carriers on the North Atlantic led eventually to construction of the mammoth White Star liners *Olympic* and *Titanic*, followed by the slightly larger *Britannic*. The *Olympic* was 850ft long with 92ft beam (*Canberra* is 820ft long with 102ft beam) and had a gross tonnage of 46,000 (*Canberra* 45,000).

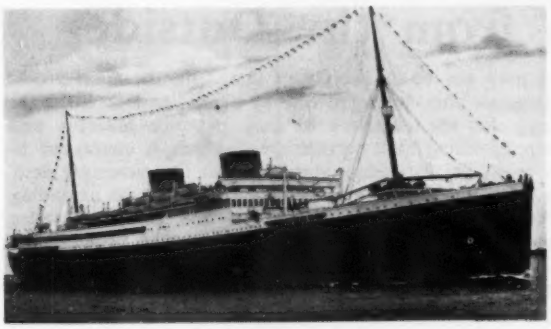


1911 — "Olympic"



1926 — "Alcantara"

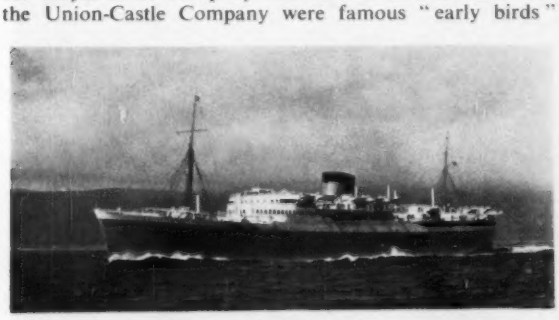
These White Star giants were indeed remarkable achievements when it is remembered that the first of them—the *Olympic*—was launched more than 50 years ago on 20 October 1910. I recall seeing the *Olympic* lying in Southampton in the summer of 1935 when I was a junior engineer on the third *Britannic*, and the great old lady of the North Atlantic was then awaiting her final orders. A long and useful life of a quarter of a century ended on



1931 — "Britannic"

13 October 1935, when she was taken to Jarrow to be broken up.

The introduction of the diesel engine to the world of marine propulsion led in due course to a new type of passenger vessel being built at the Queen's Island, and in the mid-1920s we saw the emergence of the motor ship with its squat funnels. The *Asturias* and *Alcantara* for the Royal Mail Company and the *Carnarvon Castle* for the Union-Castle Company were famous "early birds"

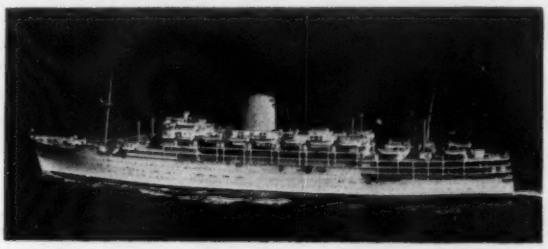


1938 — "Capetown Castle"

in this new group, and later on in 1930 and 1932 respectively came the impressive *Britannic* and *Georgic*—the last two vessels, as it happened, ever to be built for the White Star Line. The *Britannic* is, at this very moment, lying at Inverkeithing where she dominates the shipbreaking yard of T. W. Ward. I saw her in Liverpool last December when, with my colleagues, I was attending a meeting with Cunard about the new "Queen". *Britannic* will always have a special place in my affection because I once served in her, and I have always followed her progress closely.

Queen's Island has always built good ships—there is no better example than the *Britannic*—and one hopes that *Canberra* will have a long and happy life as so many other Belfast liners have had in days gone by.

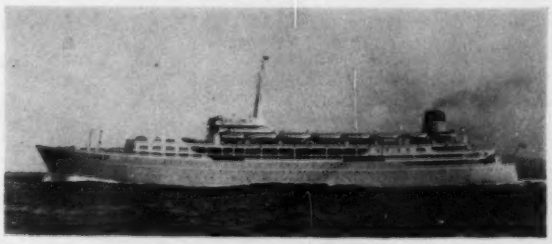
There is little room for sentiment in shipbuilding these days and there seems to be a place only for cold hard economic facts. One such cold fact with which to finish this article is that no shipyard is better equipped to build large passenger liners than the Queen's Island. Since the end of World War II we have built at Belfast no fewer than 17 passenger liners, totalling almost 400,000 grt—the equivalent of about five Cunard "Queens" in 15



1954 — "Iberia"

years, or one "Queen" every three years. This output, which gives a very good indication of the great capacity of the Queen's Island for building passenger tonnage, ranged from the yard's only Cunard liner, the *Parthia*, to the 45,000-tons *Canberra*, the largest passenger liner built by a British shipyard since the *Queen Elizabeth* 20 years ago. No British shipbuilder, and indeed no world shipbuilder, has come anywhere near matching this impressive passenger liner record in the postwar period.

The building of *Canberra* has been a great adventure. As already stated she is the largest passenger liner built in Britain since the *Queen Elizabeth*, but in addition she incorporates so many novel features that she is indeed an outstanding contribution to the British Merchant Navy. There have been many breaks with tradition, and the project as a whole represents a bold step in ship design. The pioneer work of constructing the *Southern Cross* for Shaw Savill Line placed Belfast in a strong position to produce *Canberra*. It was our task to give practical point and form to her many innovations in the light of our own shipbuilding experience and the owners' operational requirements. We believe that by the production of this further outstanding passenger liner Queen's Island has once again proved that it is a shipyard with a difference. Unfortunately, the departure of *Canberra* leaves Belfast without a single passenger liner on the stocks. May it not be long before "the sturdy ardent men" to whom Sir Winston Churchill paid tribute in his *World Crisis* are busy building another great unit for the British Mercantile Marine in the shipyards at Belfast.

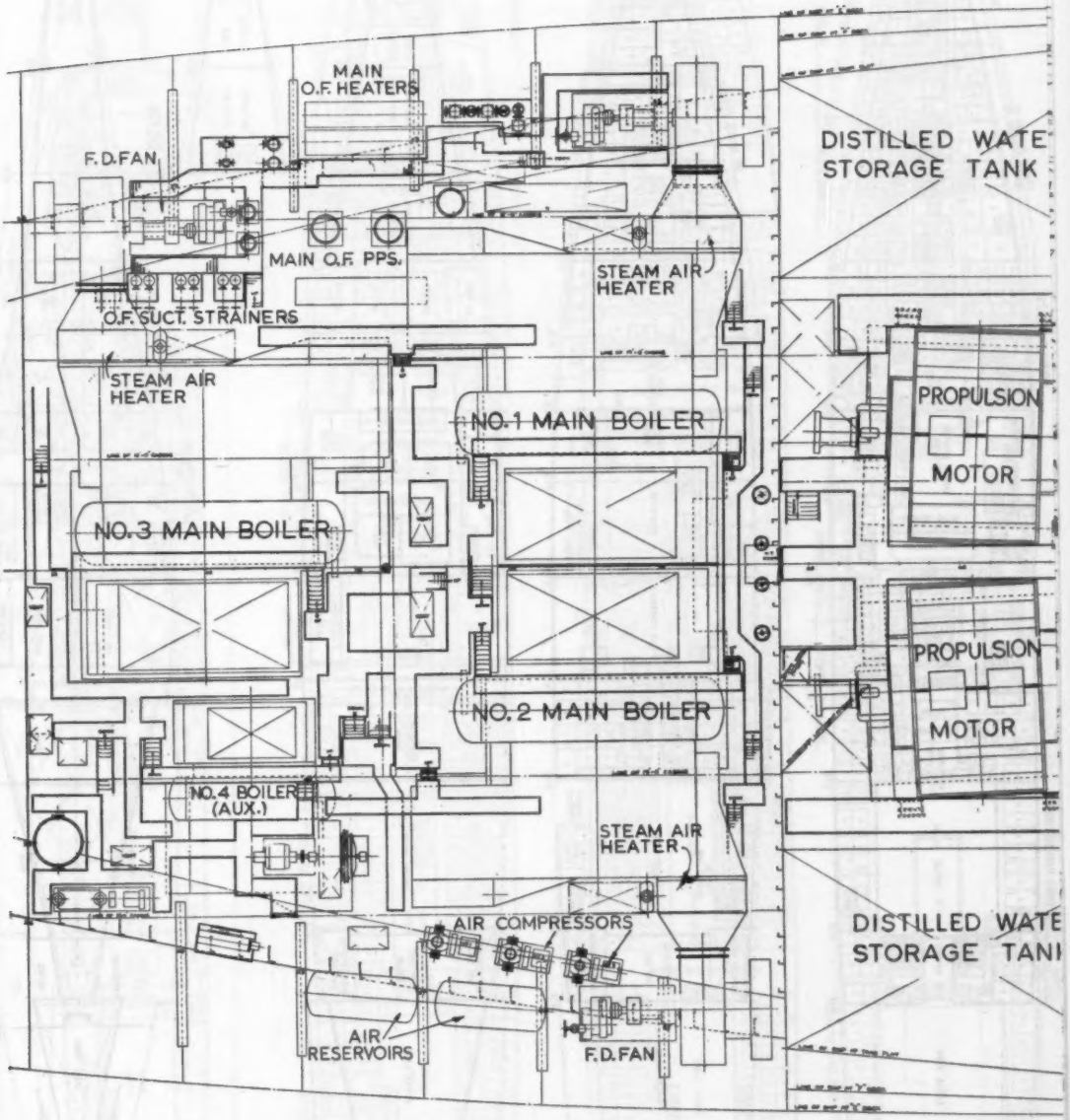


1955 — "Southern Cross"

Seen from the Outside

THE TWIN FUNNELS may not be to everyone's taste, but the *Canberra* is undoubtedly an attractive ship when viewed as a whole. Her lines are smooth and flowing, and she contrives to look at once graceful and modern. With a ship travelling at a service speed which is equivalent to more than 30 mph it is obviously important to shield the passenger deck spaces as far as possible from wind. In the *Canberra* the screens extending outwards and backwards down the after side of the bridge structure serve a dual purpose, as they give a streamlined look to the bridge while also shielding the area behind, where the first-class swimming pool is situated. The space immediately forward of the bridge, a first-class games area known as the Stadium, can be open to the sky or covered in as the weather dictates.

Potentially the worst area for wind is the after parts of the sports deck, where the tourist-class games areas are situated, and here transverse glass screens are used at intervals as windbreaks. Combined with side screens, also glazed, these divide up the area into courts which offer sheltered sitting with a deck game as a focus of interest. A gallery running fore and aft on either side, outboard of the side screens, provides convenient access; while there are doors through the transverse screens as well.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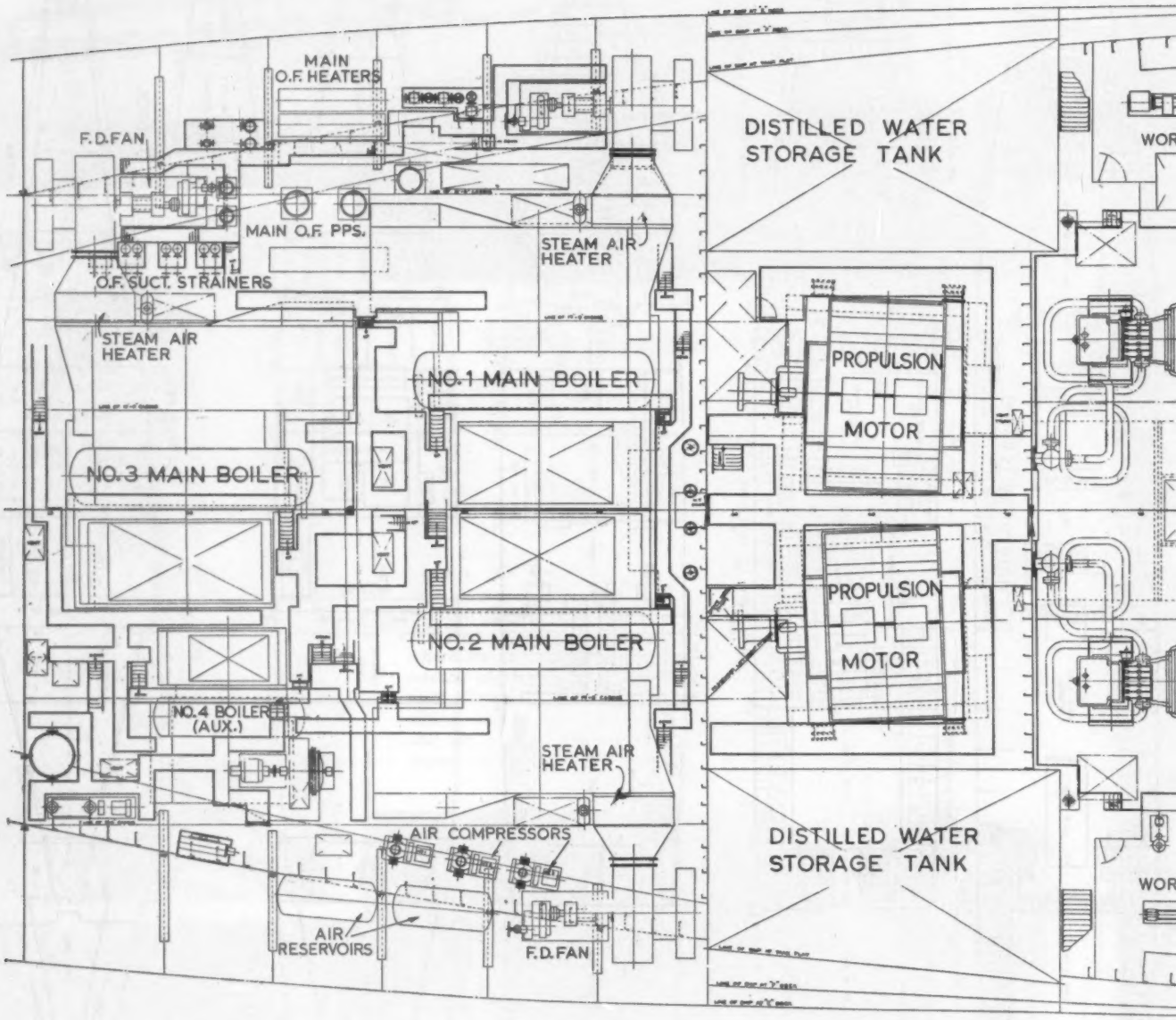
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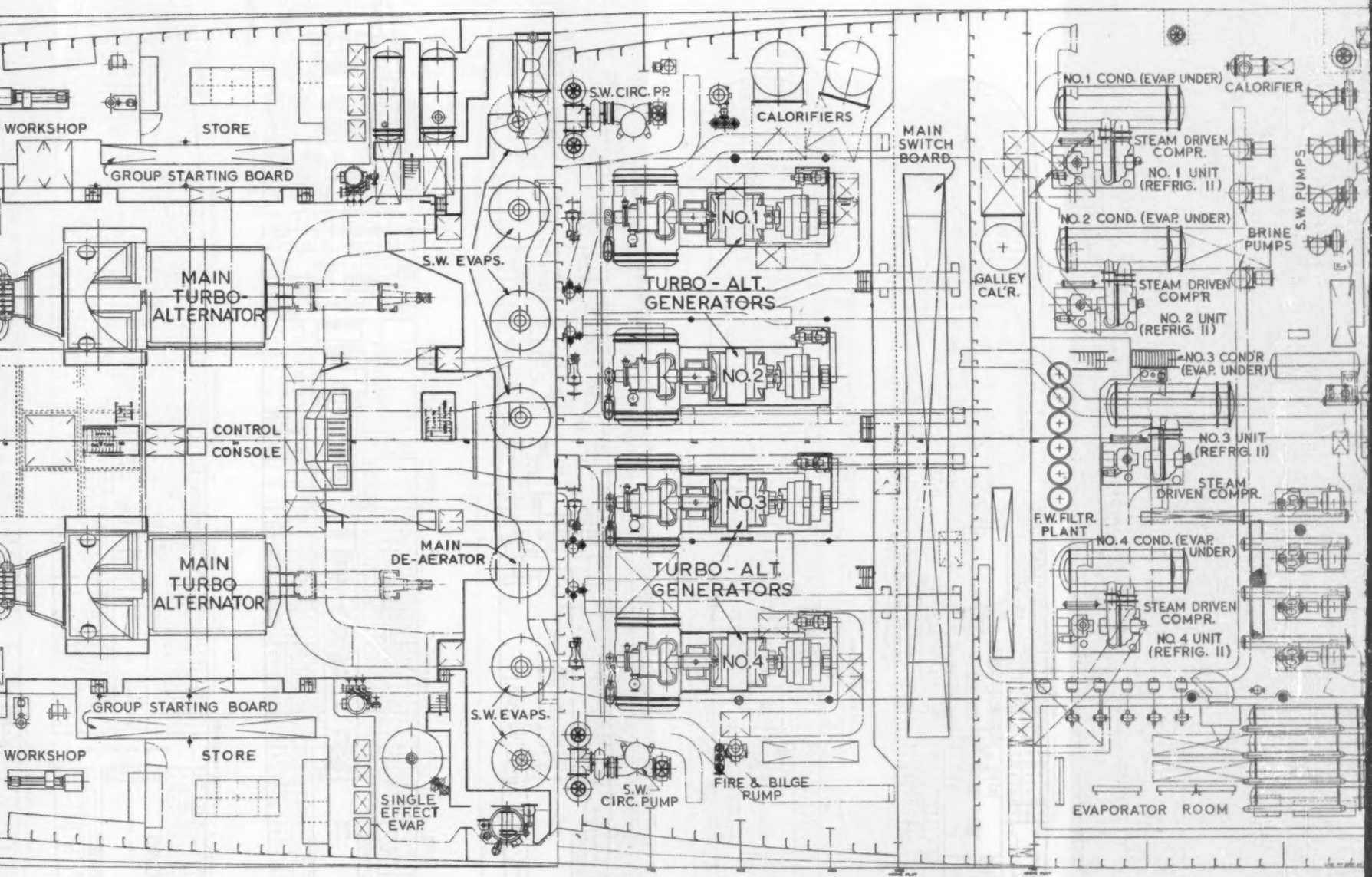
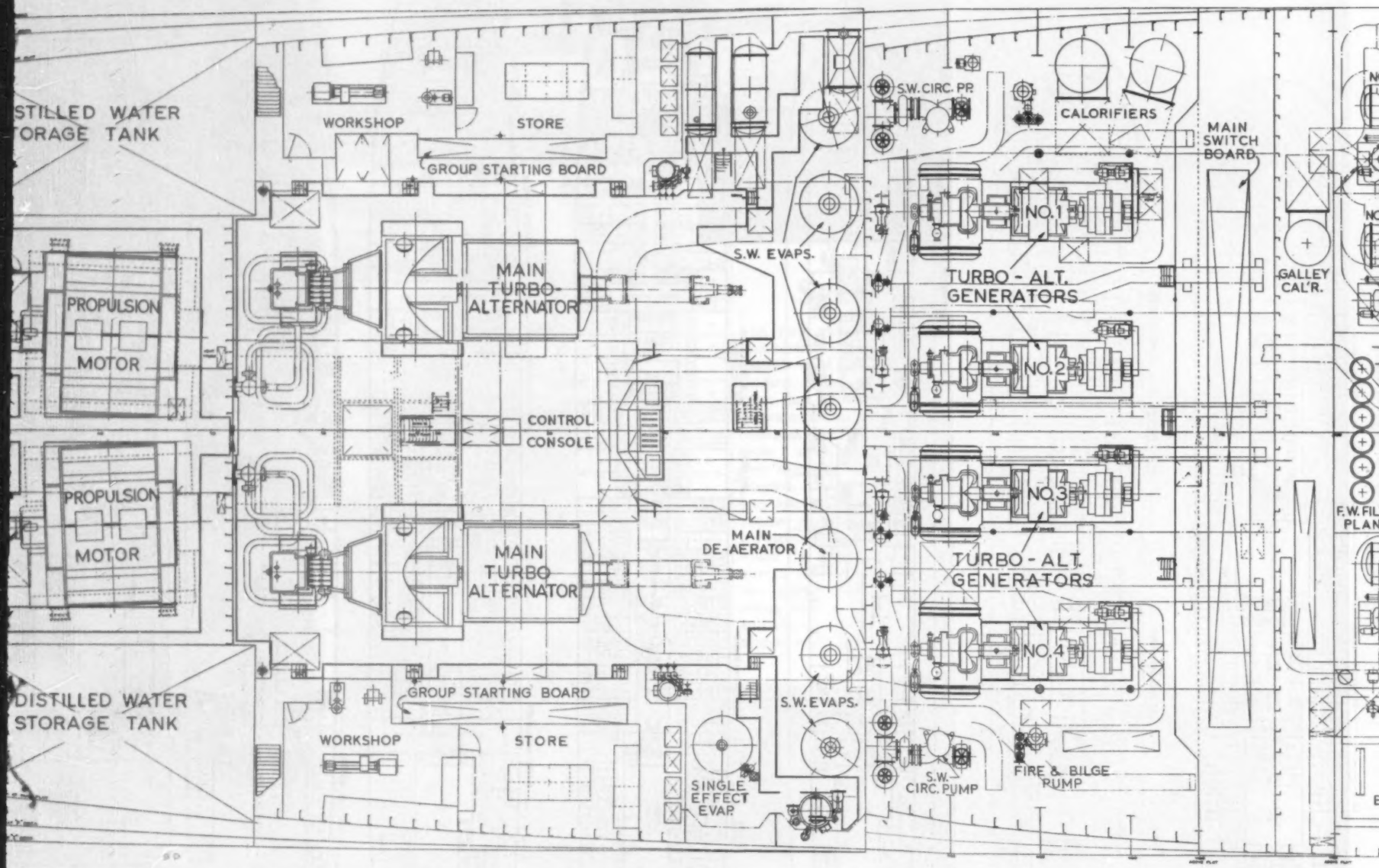
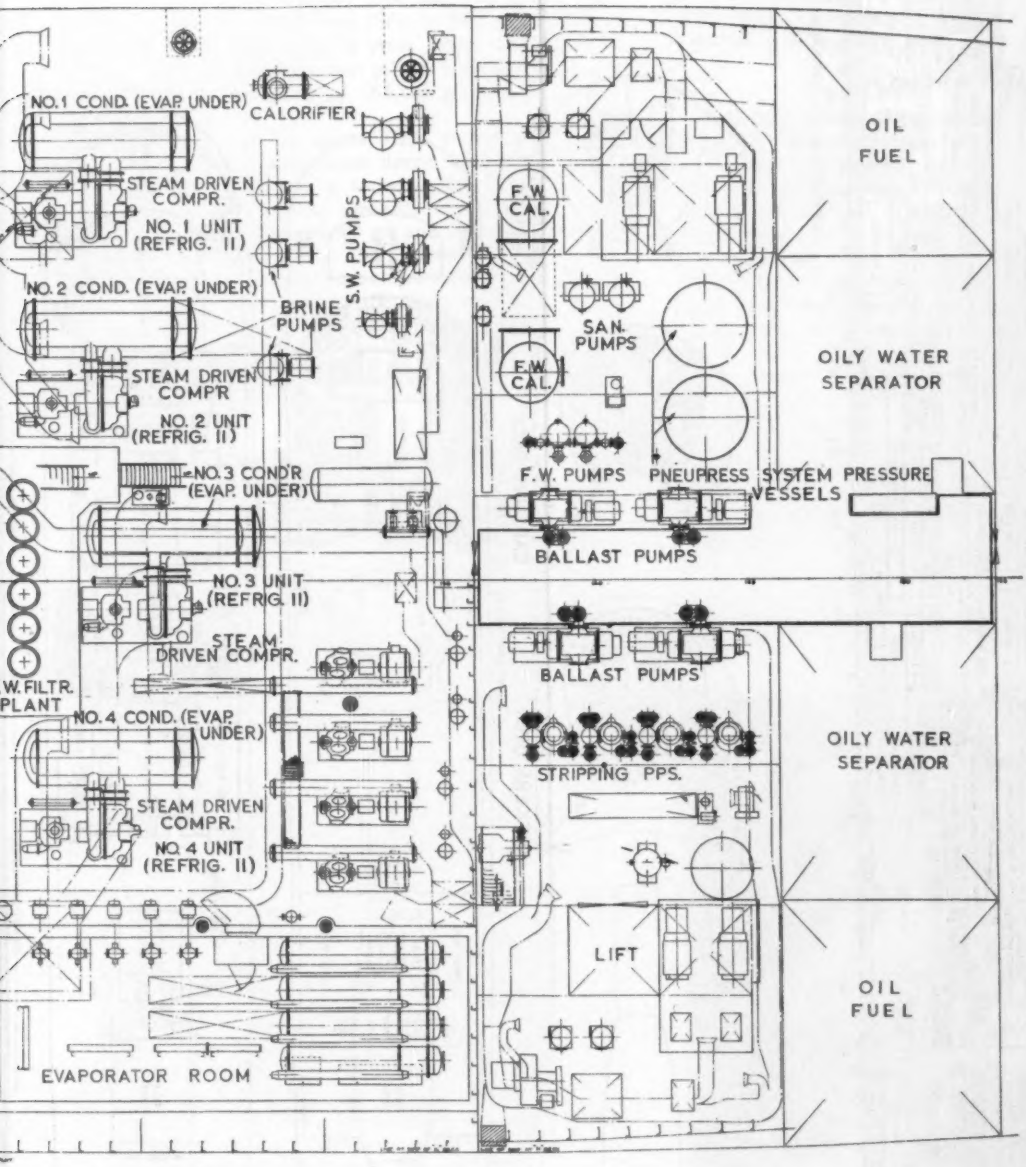


Layout of the machinery spaces of the "Canberra"



Layout of the machinery spaces of the "Canberra"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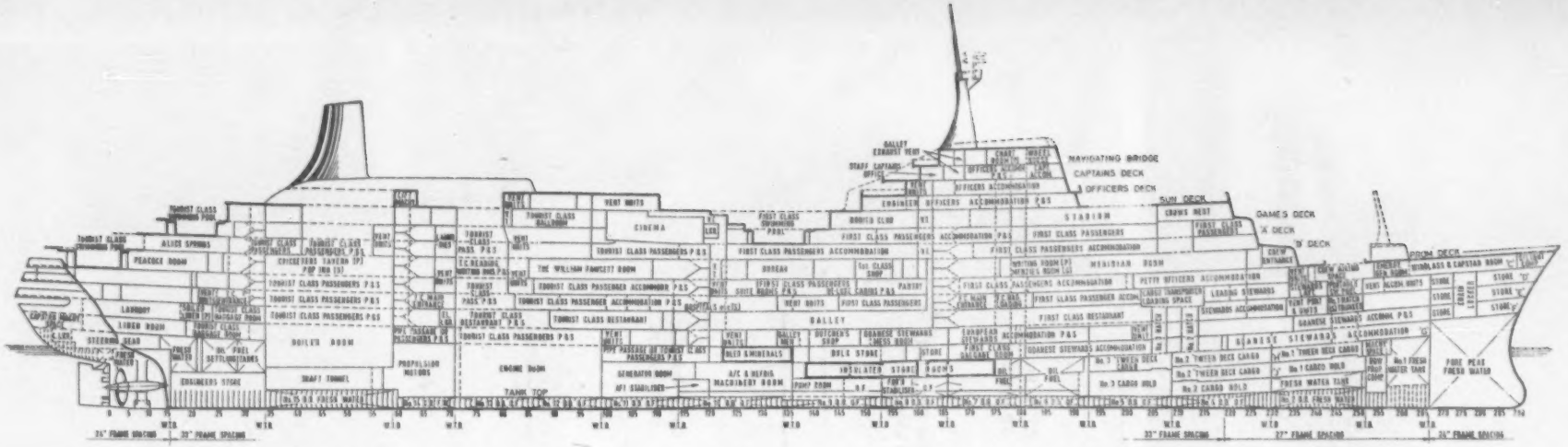
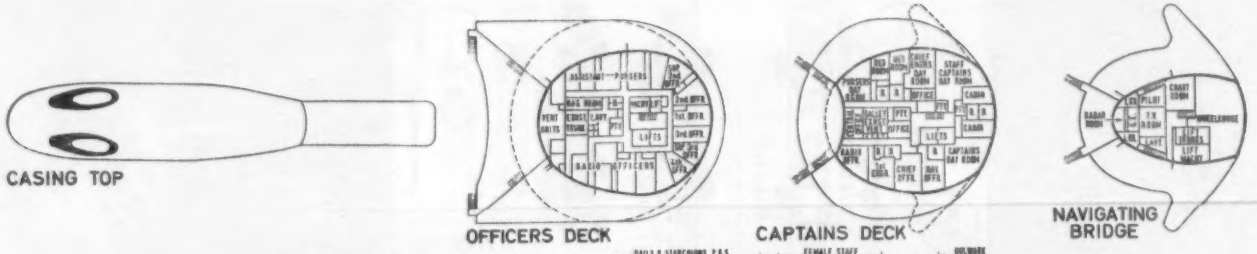
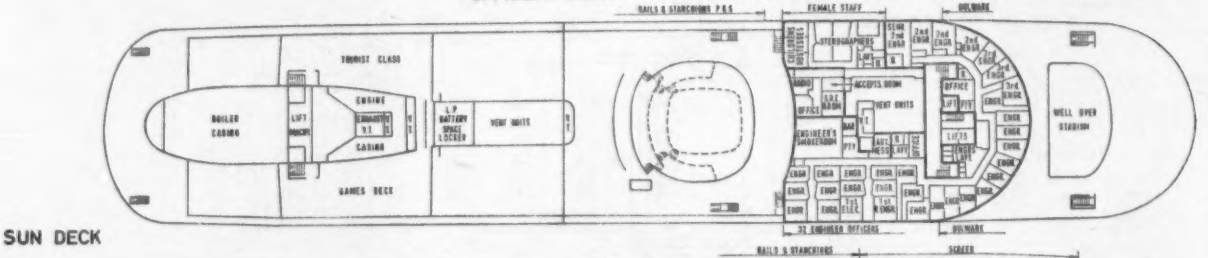
NO. 1 UNIT (REFRIG. II)
S.W. PUMPS
NO. 2 COND. (EVAP. UNDER)
BRINE PUMPS
STEAM DRIVEN COMPR
NO. 2 UNIT (REFRIG. II)
NO. 3 COND'R (EVAP. UNDER)
NO. 3 UNIT (REFRIG. II)
STEAM DRIVEN COMPR.
W. FILTR. PLANT
NO. 4 COND. (EVAP. UNDER)
STEAM DRIVEN COMPR.
NO. 4 UNIT (REFRIG. II)
EVAPORATOR ROOM
F.W. CAL.
SAN. PUMPS
F.W. CAL.
F.W. PUMPS
PNEUPRESS SYSTEM PRESSURE VESSELS
BALLAST PUMPS
BALLAST PUMPS
STRIPPING PPS.
LIFT
OIL FUEL
OILY WATER SEPARATOR
OILY WATER SEPARATOR
OIL FUEL


NAVIGATING BRIDGE
CAPTAINS DECK
OFFICERS DECK
SUN DECK
GAMES DECK
'A' DECK
'B' DECK
PROM DECK
STADIUM
CINEMA
BOILER ROOM
ENGINE ROOM
TANK TOP
BALLEY
TOURIST CLASS PASSENGERS P.S.
FIRST CLASS PASSENGERS ACCOMMODATION P.S.
FIRST CLASS PASSENGERS
TOURIST CLASS RESTAURANT P.S.
FIRST CLASS RESTAURANT
ENGINEERS STORE
DRAFT TUNNEL
PROPULSION MOTORS
GENERATOR ROOM
A/C & REFRIG MACHINERY ROOM
No 1 CARGO HOLD
No 2 CARGO HOLD
No 3 CARGO HOLD
No 1 TWEEN DECK CARGO
No 2 TWEEN DECK CARGO
No 3 TWEEN DECK CARGO
FRESH WATER TANK
FORE PEAK FRESH WATER


CASING TOP
OFFICERS DECK
CAPTAINS DECK
NAVIGATING BRIDGE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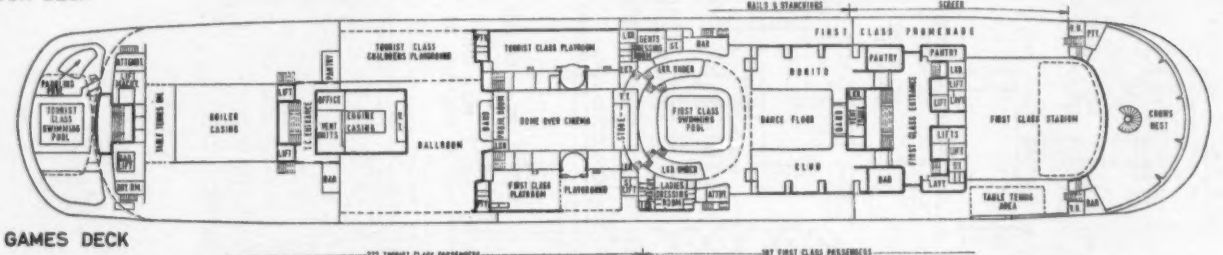
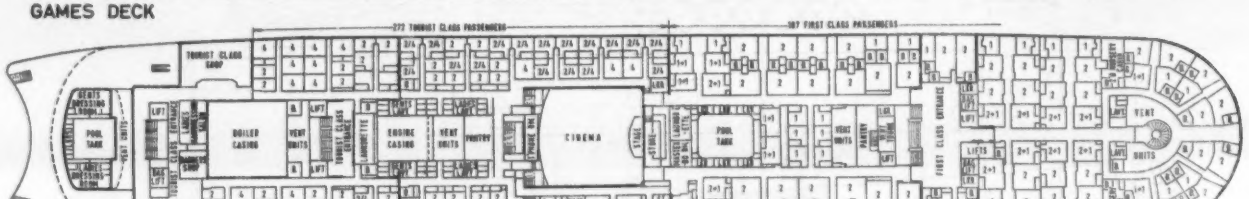
TOURIST CLASS
BOILER CASING
ENGINE CASING
GAMES DECK
WELL OVER STADIUM
32 ENGINEER OFFICERS


GAMES DECK
TOURIST CLASS SWIMMING POOL
BOILER CASING
BALLROOM
DOME OVER CINEMA
FIRST CLASS PROMENADE
DANCE FLOOR
CLUB
FIRST CLASS STADIUM
CROWS NEST
TABLE TENNIS AREA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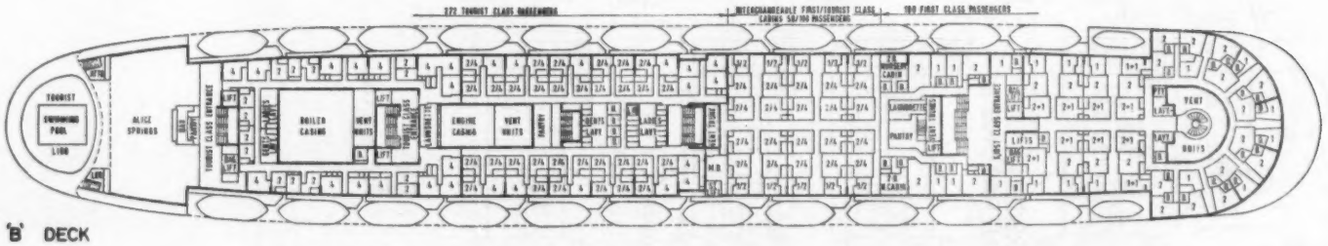
187 FIRST CLASS PASSENGERS
BOILER CASING
CINEMA
POOL TANK

'A' DECK



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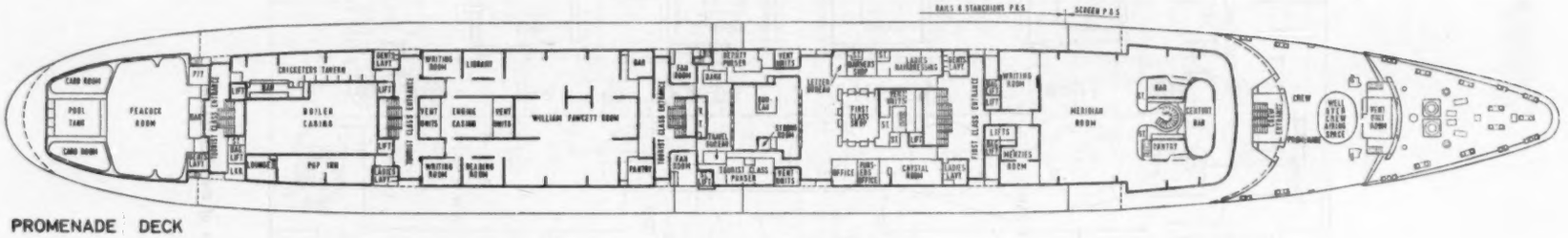
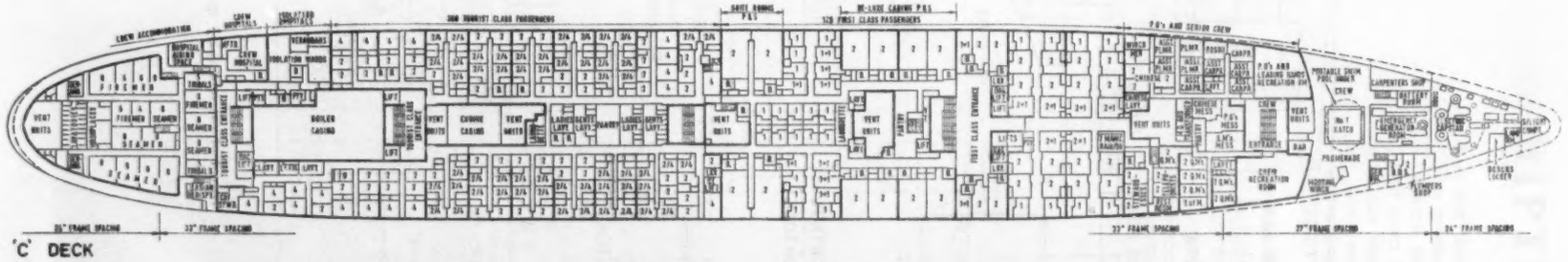


PROMENADE DECK



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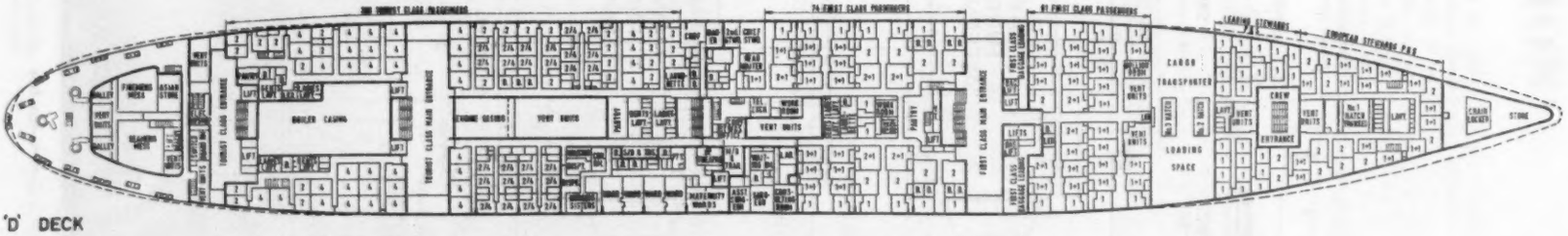

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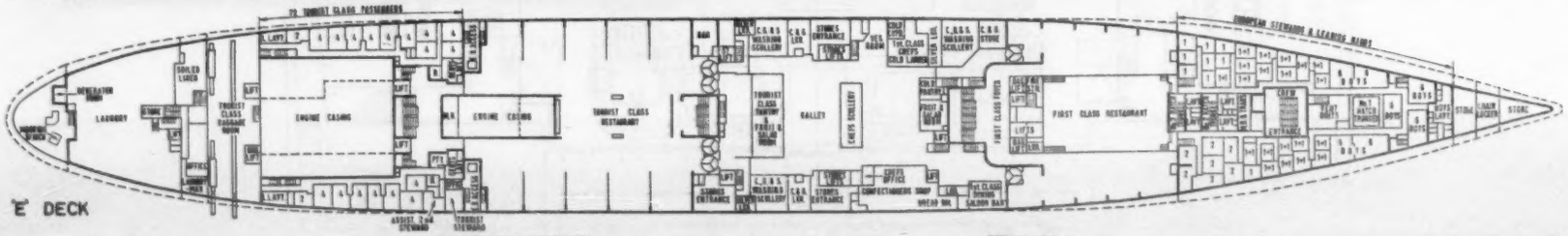

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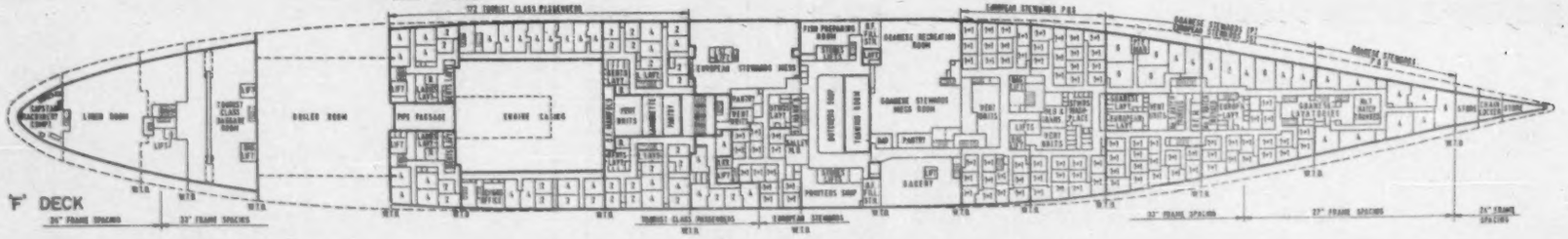
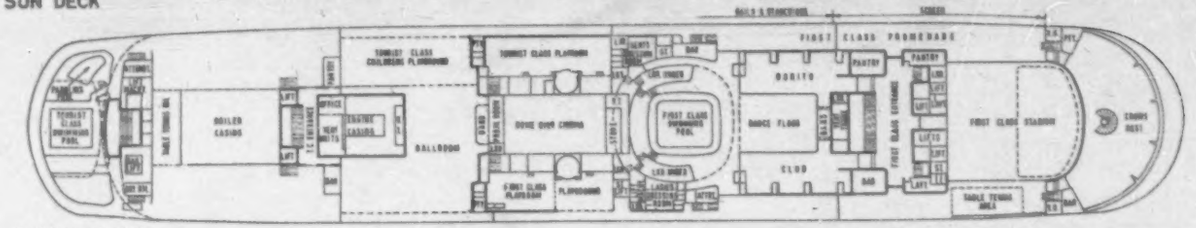


'F' DECK

SUN DECK



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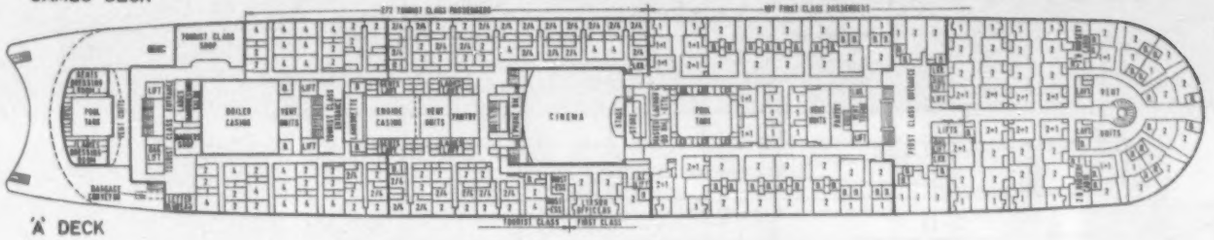

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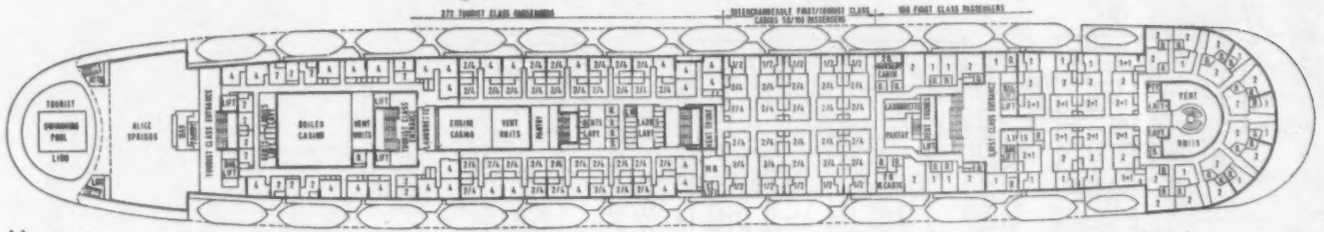

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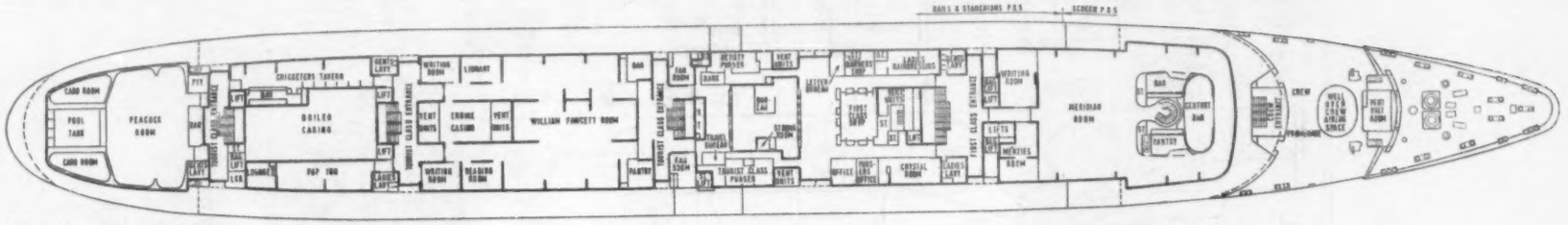

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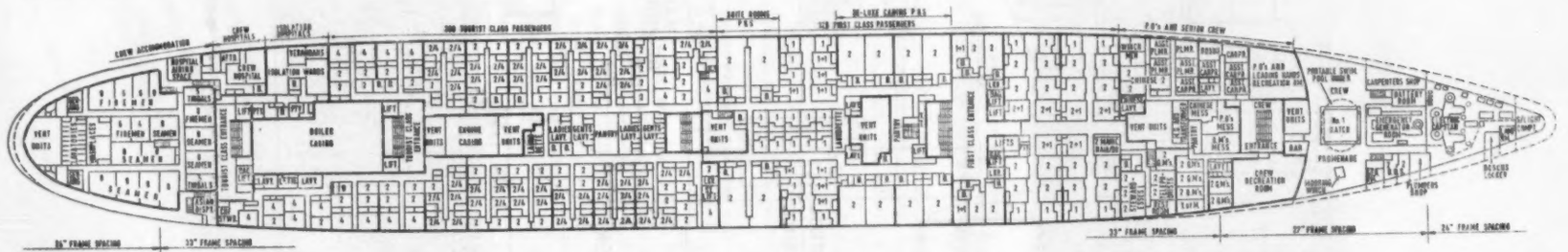

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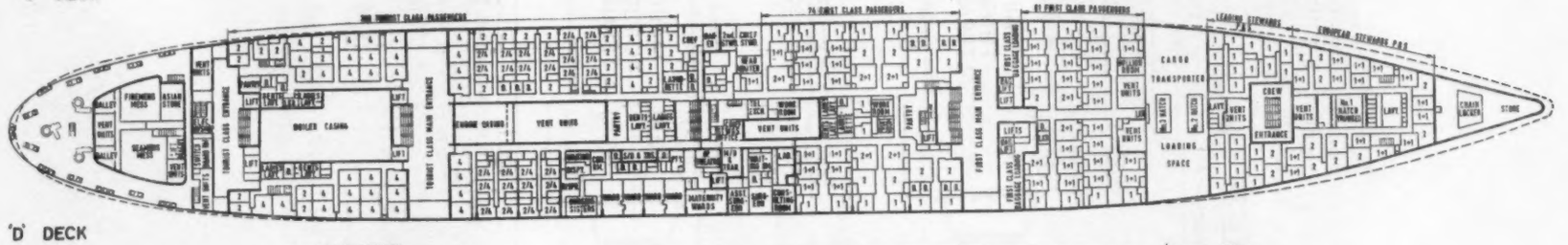

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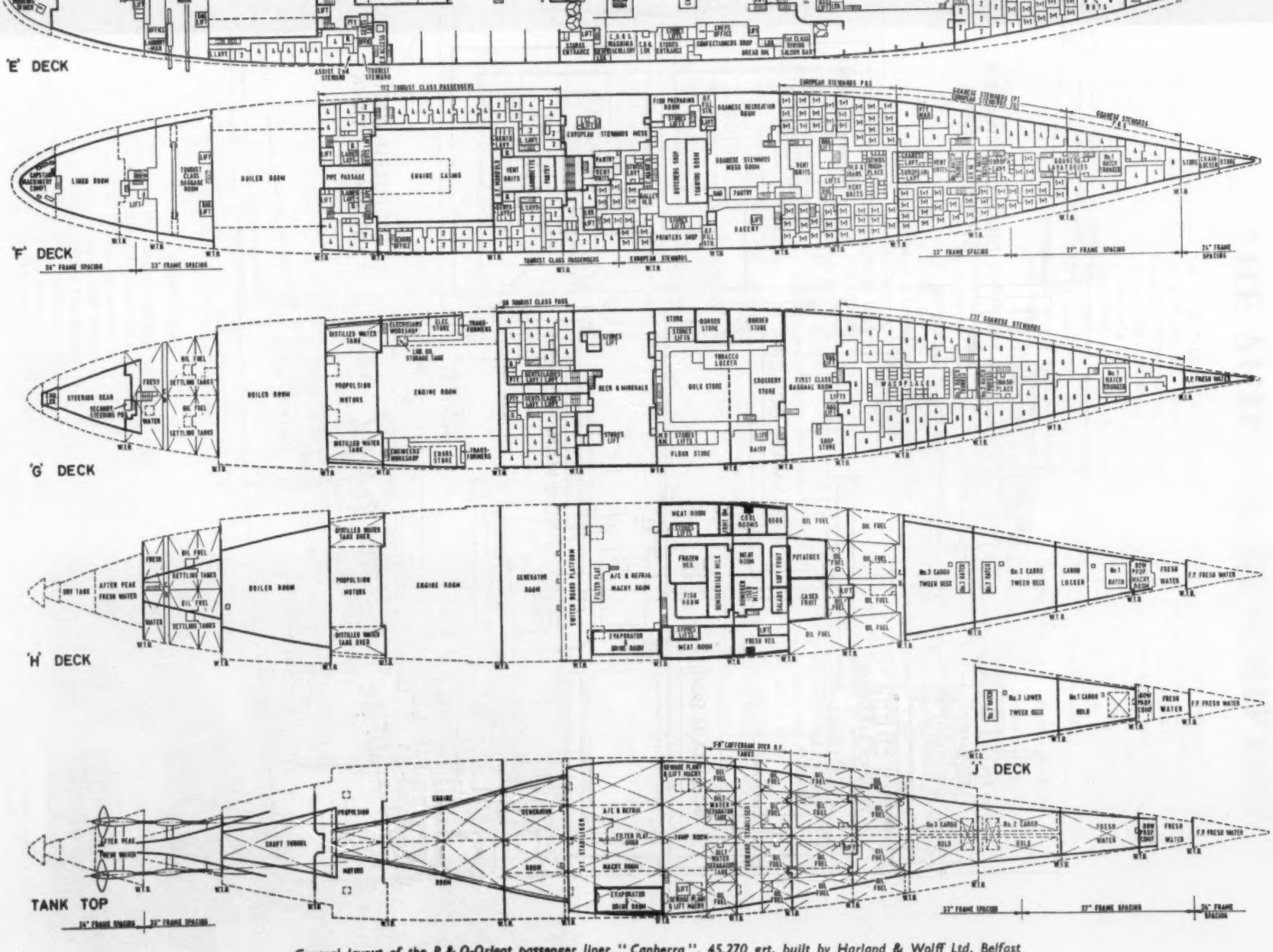
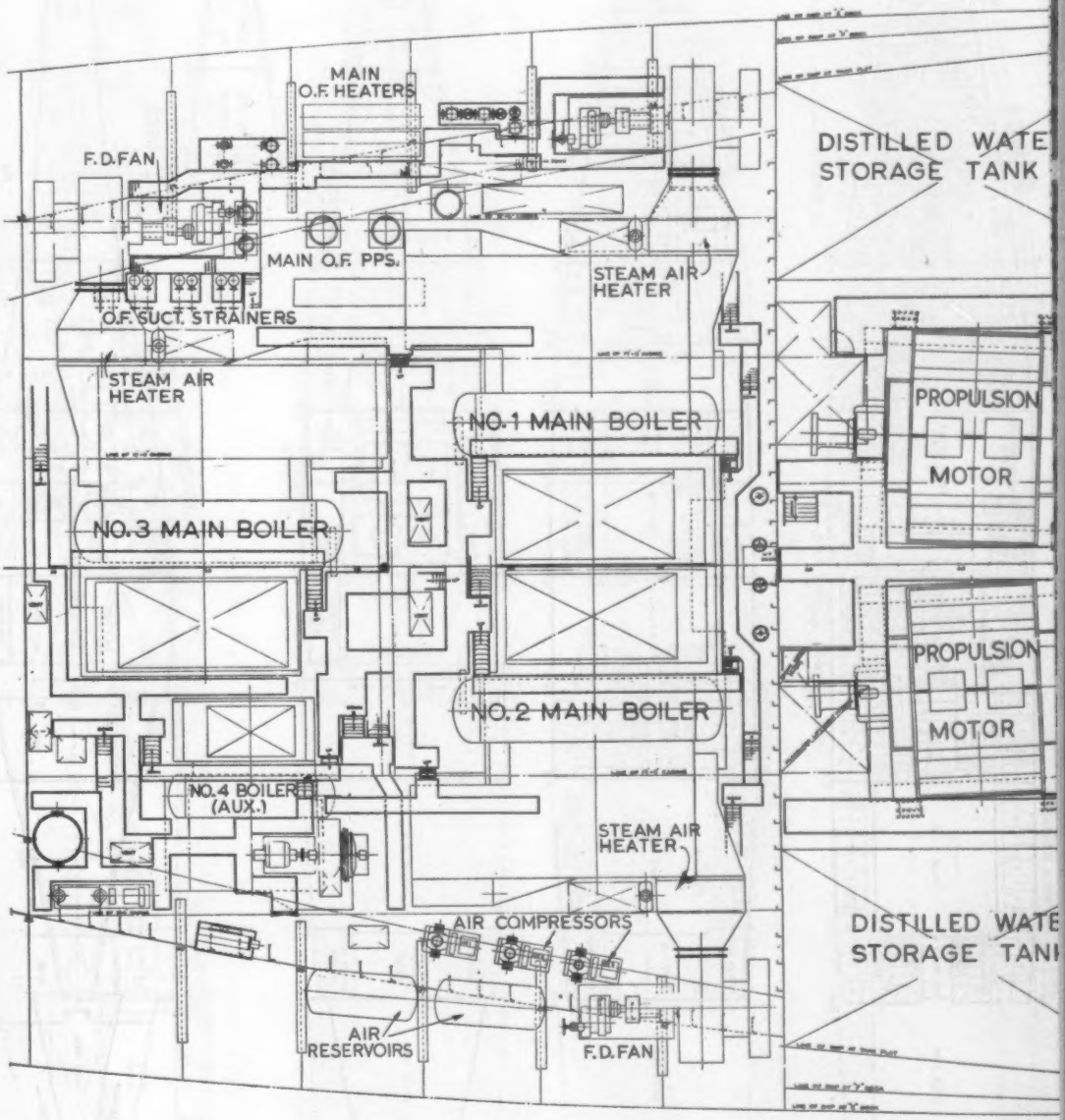


General layout of the P & O-Orient passenger liner "Canberra", 45,270 grt, built by Harland & Wolff Ltd, Belfast


MAIN
O.F. HEATERS
F.D.FAN
MAIN O.F. PPS.
STEAM AIR
HEATER
O.F. SUCT. STRAINERS
STEAM AIR
HEATER
NO.1 MAIN BOILER
NO.3 MAIN BOILER
NO.2 MAIN BOILER
NO.4 BOILER
(AUX.)
STEAM AIR
HEATER
AIR COMPRESSORS
AIR
RESERVOIRS
F.D.FAN
PROPULSION
MOTOR
PROPULSION
MOTOR

THE SHIP : A DESCRIPTION

THE *Canberra* was built for P & O-Orient Lines at the Belfast shipyard of Harland & Wolff Ltd, where she was Yard No 1621. She is a twin-screw turbo-electric passenger liner of some 45,000 tons gross. The keel of the ship was laid on 23 September 1957, she was launched (by Dame Pattie Menzies) on 16 March 1960 and she was handed over to her owners on 19 May 1961, so that her construction took rather more than 3¼ years. With completion of the *Canberra* the passenger fleet of P & O-Orient Lines has been brought to 18 ships of 463,313 grt—the largest in the world.

The *Canberra* and the similar-sized *Oriana* represent a new generation in P & O-Orient liners. With a tonnage of over 40,000 grt each and a service speed of 27½ knots, they are a marked jump upwards from the previous postwar vessels of about 30,000 grt and 22 knots. Together they have cost about £30 m. The new size and speed were dictated partly by postwar economics favouring the larger and faster unit, and partly by the desire of P & O-Orient to exploit to the full the trans-Pacific trade which has been developed by the company since it was pioneered by the Orient Line in 1954. The long distances in the Pacific were again an inducement towards high speed, and therefore large size.

More Passengers than any other Ship

As a result, the *Canberra* can claim to be the largest passenger liner built in Britain since the *Queen Elizabeth*, and can carry more passengers than any other ship in the world. Her passenger capacity totals 2,238, of which 548 are first-class and 1,690 tourist-class. These numbers can vary, as there are interchangeable cabins, which accommodate two as first-class and four as tourist-class cabins. The *Canberra* and *Oriana* are too large to pass through the entrance lock at Tilbury, and both use Southampton as a terminal port. This choice also shortens slightly the distance travelled. The voyage to Australia takes three weeks (to Fremantle).

The *Canberra* has an overall length of 818ft 3 in, and a length between perpendiculars of 740ft. Her moulded beam is 102ft, moulded depth 41ft 6in, and draught at full load 32ft 6in. It will be observed that her main deck is only 9ft above the waterline, all higher decks being technically shelterdecks. If care had not been taken in the design to keep her gross tonnage to a minimum, it could well have been 10,000 tons higher. The exact gross tonnage of the ship is 45,270 tons, and the net tonnage 23,968 tons.

The superstructure above the weather deck consists of aluminium, and is the largest to be fabricated in this material, with a weight of over 1,100 tons. The use of aluminium in this way allowed an extra superstructure deck to be added, and made it possible for several hundred more passengers to be carried. Weight was also saved by the general use of welded construction. The shell plating of the hull has welded seams and butts, and is riveted to the frames. The superstructure is also welded.

Unusual Layout

The layout of the ship is unusual in several ways. The propelling machinery has been sited aft, as near the stern as possible, thus giving the centre of the ship entirely to passenger accommodation and removing sources of vibration as far aft as possible. The lifeboats are situated three decks down, where their weight is lower, and where they do not obstruct the view from the sports deck. A height of 20ft is needed between decks for the lifeboat stowage, and as this was wasteful if used for two cabin decks it was decided to have one deck of public rooms at this level, giving access to a promenade beneath the lifeboats. There are thus two separate decks of public rooms, three decks apart, quite apart from the restaurants lower in the ship. The opportunity has been taken to separate as far as is practicable the public rooms which are likely to be noisy from those which will probably be quiet, the quiet ones being at the lower level.

Public Rooms

First-class public rooms include an observation lounge (the Crow's Nest), ballroom (Bonito Club), children's playroom and playground on the Games Deck; lounge (Meridian Room), and a writing room, library (Menzies Room), Century Bar, private dining room (Crystal Room), hairdressing salons, shops, etc., on the Promenade Deck. The restaurant is on E Deck. Public rooms for tourist class include a children's playroom and playground, ballroom (The Island Room) on the Games Deck; shop and hairdressing salon on A Deck; pool café (Alice Springs) on B Deck; lounge (William Fawcett Room), reading rooms, library, Cricketers' Tavern, Teenagers' Room (Pop Inn), smokeroom and card rooms (Peacock Room) on the Promenade Deck; and a large restaurant on E Deck.

A cinema with a seating capacity for 332 has been provided centrally on A Deck for the use of either first-class or tourist-class passengers. This is provided with the latest projection equipment suitable for wide vista viewing.

The three swimming pools which are provided for passengers have been designed on a more lavish scale than usual. A feature of the first-class swimming pool is the terracing which has been arranged around three sides. The decks of the terraces are laid with parquetry flooring

First-class swimming pool and sports decks, with tourist-class games spaces further aft

The first-class swimming pool. The Bonito Club is on the right, out of the picture

and the pool and surround covered in Italian glass mosaic. Another feature of the first-class pool is the vertical sliding hydraulically-operated aluminium glazed screen which, when open, allows the Bonito Club and swimming pool to be combined as a Lido.

Two swimming pools at the after end of the ship have been provided for use of tourist-class passengers—one on the Games Deck and one on B Deck. Once again the use of glass mosaic has been employed extensively.

The swimming pool on the Games Deck has, in addition to the pool itself, a children's paddling pool on the port side. The whole is enclosed by specially designed wind breaks covered with mosaic. The swimming pool on B deck has a fountain in the area surrounding it, which can be illuminated by coloured lights, and the adjacent public room (Alice Springs) can be combined with the swimming pool area by opening a hinged aluminium glazed screen. The mosaic motif around this pool has been extended to include the walls and flying wings in Alice Springs. All passenger swimming pools have underwater lighting.

An ingenious method of hydraulic operation of No. 1 hatch covers has enabled this trunkway to be used as a swimming pool for the crew—an unusual feature in a passenger liner.

Successful Cabins

In their general conception and design, the passenger cabins are undoubtedly one of the most successful features of the ship. They include in the first-class groups of cabins arranged round courts, the bulkheads being stepped so that each cabin has a view of the sea through a narrow window in the stepped portion and through the portholes at the end of the court. This idea has been tried in foreign ships, but it was first introduced in a British ship with the *Oriana*. It gives a sufficient visual outlet to avoid the feeling of claustrophobia which can come from a totally-enclosed cabin, and is much more economical of space than the Bibby cabin which is the only obvious alternative, as well as being better suited to a fully air-conditioned ship.

Every first-class cabin is provided either with a private bathroom or a specially-designed shower and W.C. unit completely fabricated in glass fibre. A certain number of first-class cabins are arranged with Pullman berths, the lower bed being converted into a settee during the day.

An unusual feature in the tourist-class accommodation is the provision of a number of convertible cabins. These can be used as a two-berth cabin with private toilet and shower, or can be converted in a matter of minutes into a four-berth cabin. In addition to this a number of Tourist Class cabins are provided with a private shower and toilet. Communicating doors have been fitted where practicable to enable cabins to be let to families. A certain number of dressing tables have also been specially designed so that these can be easily re-positioned to allow children's cots to be fitted in the cabin if necessary.

Like other P & O (as distinct from Orient) ships, the *Canberra* has a high proportion of Asians in her crew. The majority of the stewards are Goanese, the engine-room crews are largely Pakistanis, and the deck crew Indians. There are also a few Chinese on board. In a ship of this class it is expected that the officers' accommodation will be good, but it is not always easy to maintain high standards when a large crew has to be accommodated in addition to passengers. However, the *Canberra* can offer her crew excellent accommodation. As with the passenger accommodation, it is air-conditioned throughout.

Deck officers and engineers are accommodated in the superstructure round the bridge area, from which a lift extends down to the forward end of the machinery spaces. Petty officers, leading hands and ratings are berthed forward on C Deck and G Deck. Among the facilities provided, each crew cabin has a socket which can take an electric razor or a personal radio set, while in addition the ship's radio system with its choice of two programmes is available throughout. Good mess and recreation rooms are provided, and these have provision for religious services of the various denominations carried. The recreation room for the Goanese stewards (who are Portuguese nationals and Catholics) is illustrated on a later page.

The use of timber for decks has been kept down to the areas where it is particularly desirable, such as sports decks, which are of teak. Elsewhere modern compositions have been employed. On stair treads of weather deck ladders, Semtex Gripdec is used. Elsewhere on weather decks either Rowan & Boden's Aranbee Neodek or Semtex Semprene Extra are used. These two firms, incidentally, have also been responsible for internal flooring, for which Rowan & Boden has supplied Korkoid.

Fire Protection

Fire protection in the ship is by Method II—the normal method for British passenger liners. A sprinkler system is fitted throughout the accommodation spaces, with A Class divisions being of fireproof materials. In the cabins, the sprinkler head has been combined with the ventilation outlet and the internal broadcast loudspeaker into a single ceiling unit. On the bridge there is a comprehensive installation of fire detecting equipment. It is possible to shut off the ventilation fans in a part of the ship affected by fire,

# of decking and flooring on the s.s. Canberra

When a liner sets out on her maiden voyage it is a proud moment for the men connected with her birth. The s.s. Canberra is the latest vessel to be installed with Semtex flooring. A company long associated with decking and flooring, Semtex Ltd., are manufacturers of the finest and most reliable materials and provide expert installation and maintenance services in all leading maritime countries.

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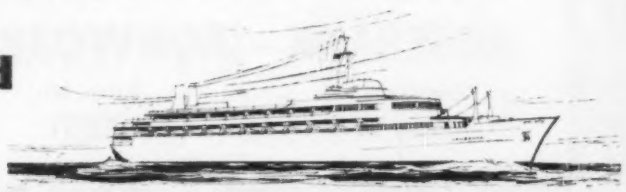

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INTERIOR DESIGN IN THE "CANBERRA"

THE INTERIOR DESIGN of a passenger liner plays a most important part in the success of the ship. In the case of the *Canberra*, the main work of designing the interior of the ship was divided between three distinguished architects, under the general supervision of Mr John West. Sir Hugh Casson, trying his hand at passenger liner work for the first time, has been responsible for the first-class public spaces. Mr John Wright and an assistant have been largely responsible for the tourist-class public rooms. Miss Barbara Oakley designed the furniture for the passenger cabins and suites, and for the officers' cabins and crew messrooms, and was also responsible for the decoration of these spaces. In the articles that follow, the three architects concerned discuss their approach to the problems that confronted them.

Problems of Interior Design—and Their Solutions

By SIR HUGH CASSON

SHIP INTERIORS demand simple forms, clean surfaces, clear colours and good serviceable materials left to speak for themselves. Gimmicks quickly become tedious. The latest fashion is within a few months a yawning bore. Too many patterns, too many colours, too much art, too much diversity of character—all devised in well-meant endeavours to achieve "interest"—defeat in the end their own object. And if this sounds dull, remember first that a ship is full of people providing their own constantly changing pattern of colour and movement; secondly that it moves constantly from one climate to another and thus from one quality and type of daylight to another; and thirdly that there is always the magical, ever-present background of the sea itself, with whose vanity of mood and colour no designer can ever compete and a spectacle of which no eye can ever tire.

So much for principles. How have we interpreted them? First by looking facts in the face. Here are some of them. *Canberra* will spend seven-eighths of her time in sunny regions. Most of her passengers will probably spend at last 25 consecutive days on board. The extension of her route to Honolulu and San Francisco means that many of these passengers will be American, whose tastes in food, entertainment and surroundings may differ from those of the British or Australian. Tourist-class passengers tend perhaps to be younger than first-class passengers. (There will almost certainly be more children.) There is the seasonal emigration trade to be catered for. Finally, a ship that is as large and expensive to run as *Canberra* must work hard for her living. This means quick turnround and the minimum of time for decorative maintenance or repair.

Together with these facts comes the owner's brief—the proportion of space to be allotted to each activity, the number, size and quality of finish required of public rooms, and their relationship to each other both vertically and horizontally. These, basically determined by the naval architect, are if necessary or desirable adjusted and varied within permissible limits. These limits—some set by safety regulations, others by structural requirements—may often be frustrating to the designer, but are easier to understand and grapple with than the less tangible factors that govern his decisions.

The design principles, the brief of requirements referred to above, the physical limitations—and of course the budget—are now established. How are they to be expressed? Obviously it is too complex a task for one man to accomplish in the time. Two alternative approaches then suggest themselves, both equally defensible. The first, adopted in P & O-Orient Lines other new luxury liner *Oriana*—is to achieve the variety and contrast of needs and moods in engaging a team of architects, designers and artist-craftsmen to work under central coordination but each within

The officers' wardroom

One of the two card rooms opening off the Peacock Room, with the main room beyond

his own area of operation—usually one or two public rooms. The second, adopted in *Canberra*, is to reduce this design team, again under central coordination, to a minimum of three, i.e. first-class area, tourist-class area, and cabins.

Every ship, after all, is an individual and quickly develops a personality of her own. The more consistent the visual "handwriting" that runs throughout every inch of her the better. Throughout the first class accommodation in *Canberra*, for instance, ceilings are almost universally white and kept as flat and unbroken as it is technically possible. The rubber floors of staircases, alleyways, entrances and the carpet of the principal public room (the Meridian Room) are the rich blue-green of the Pacific. Walls are almost universally either of dark smokey woods—Persian walnut, Indian laurel or else white. Bright colours—flames, pinks and oranges—are either (as in the Bonito Club) kept concealed by day and brought out only at night, or confined to areas (such as the cinema) untouched by daylight. Satin silver metalwork, opalescent glass-fibre, polished glass and natural leather and cane, almost complete the range of materials used in these areas.

In the tourist area, by contrast, where spaces are larger and the required atmosphere is to be less discreetly quiet, colour and textures are used boldly and generously—gay mosaics and richly translucent gold-foil panels, murals—one more than 200ft long—and fountains, woods as pale

The tourist-class Cricketers' Tavern

as willow, as dark as rosewood, or stained to a strong stinging blue. Ceilings are sculpted to subtle forms. Throughout both areas the lighting has been flexibly devised to change to meet the mood of the moment or the time of day. Linked by the blue-green floors and predominantly white walls of the alleyways are the cabins, large and small, mostly in natural woods set against white walls, where vivid colours are kept to occasional and very carefully considered points of emphasis.

But the designer's work is not yet over. Even the most elegantly conceived room can be ruined by one false touch. Every detail—be it an ashtray or a clock, pickle-fork or a teapot, a face-towel or a door-handle—must be chosen or specially designed for the job it has to do, at the given price. Here again visual consistency is all important, and some degree of standardisation only commonsense. *Canberra* has her own alphabet—used throughout—and her cutlery, crockery and glassware have been specially designed to replace in due course the standard equipment (and to fit existing racks) throughout the rest of the P & O-Orient Lines' fleet.

Mess and recreation room for Goanese crew members. The altar is shown opened up

New Ideas For Tourists

By JOHN WRIGHT

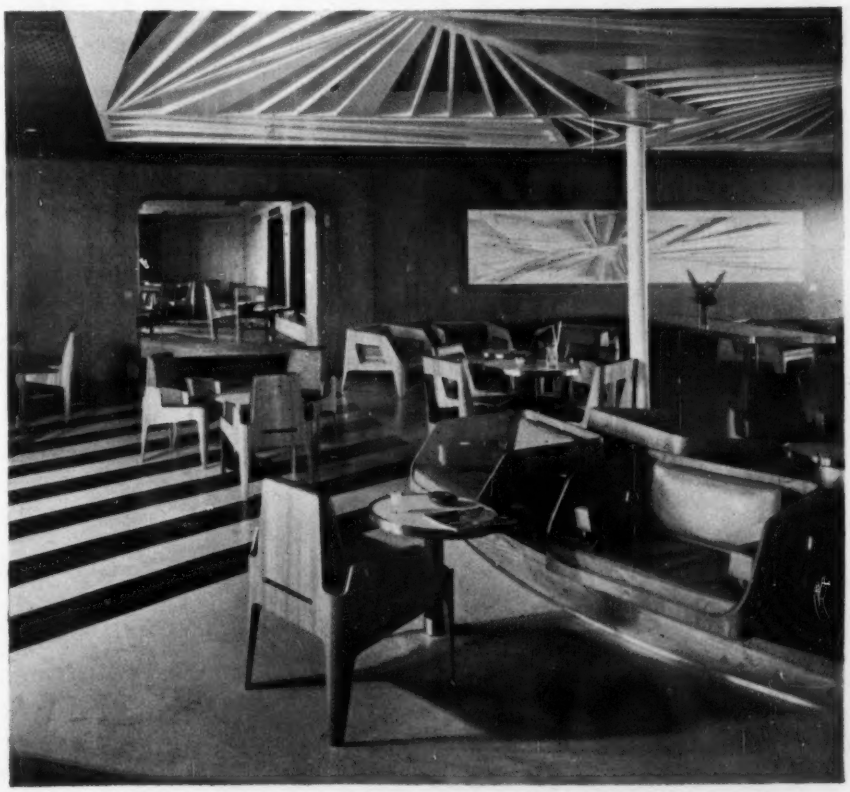
APART from the urge to do something different, quite the greatest influence on my design in the tourist-class public spaces was the increased prosperity ashore of the average passenger in that class. This upgrading of standards made me reconsider both the purpose and the treatment of the areas allowed. In the past there have been a number of public rooms seating a number of passengers, based on a ratio of space per person. This ratio could not be altered, but we have re-allotted the room and divided the people differently. The middle-aged and the elderly are able to get away to the quiet of the Peacock Room where they may also play cards. The William Fawcett Room, which will take by far the largest number of people at one time, is really the main sitting-room. The Pop Inn is intended for teenagers: and, of course, there is a playroom for the children.

The Peacock Room, which is well aft, curves inwards towards the stern, where there are two small cardrooms. The walls are all curved and panelled, as is the ceiling, in blue dyed veneers, hence its name. The floor is of white polished rubber and one small section is diagonally striped with black and will be cleared in the evenings for dancing. Over the centre part of the room there is a sculptured canopy designed by Robert Adams, through which the light filters. Opposite a waiter service bar forward there is a mural bas-relief by the same artist. Club easy chairs are fixed in a serpentine arrangement in the middle and these chairs and the rest of the furniture are of bent plywood veneered in pine and covered in leather. Opening off, the two small cardrooms are carpeted and are panelled in pine. The curtains, which match those in the Peacock Room, are of Thailand silk.

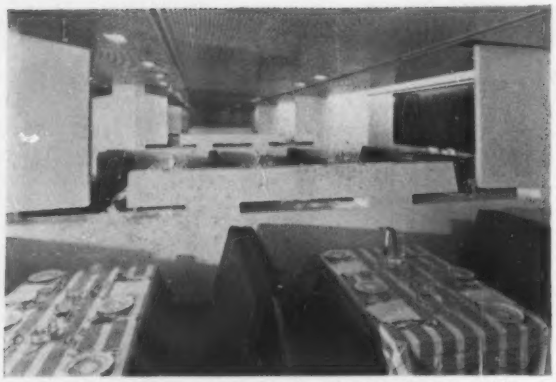
The William Fawcett Room will become the main meeting place, and is very large. Each side there are small writing-rooms and a library. The entire floor is carpeted in a plain dull gold. The inboard walls are of Blackbean wood and those outboard are of translucent silver-white glass fibre. The very low ceiling is painted white. Mural panels of tinted and textured mirror glass and foils by Robert Goodden decorate the main fore and aft walls and also some side screens. The furniture, as in the Peacock Room, is a design specially evolved for the *Canberra*, cut from a drum of plywood, with drop-in seats and simple arm and back pads, all easily upholstered and re-upholstered. In this room the covering materials are a bronzed green leather and a pure silk tweed in two purples. The main point of interest here are the twin fountains, in which fluorescent water in glass tanks spurts up through jets balancing ping-pong balls. More of these "water scapes" are used in the principal entrances, where they are framed on the bulkheads, and each one is different.

Passengers on a long sea voyage are the perfect captive audience for an interior architect. They are nevertheless a very critical audience, perhaps more so now than ever before, since there is such a popular interest in design and decoration. For this reason it is important that the spaces should not be boring or slight, and that the design should be strong. I think the difference between design and decoration should be very clearly marked and understood by anyone attempting interior work of this kind. Therefore it is of the greatest importance that he should work all along with the naval architect, so that they may interpret each other correctly and so that the inside shall "speak in the same language" as the bones of the ship. In many cases it is of advantage to the designer that the plumbing or some part of the "guts" should appear in his spaces, for though they may present a problem they may well also give him a peg on which to hang his scheme. Thus by exaggeration or by heavy disguise of that feature, the character of the room may be determined. This I think is the only true form of "nautical design" that may consciously be used in ships today.

This problem arose in the Restaurant, where some soil pipes had to be routed at intervals down each side of the room. In this case the cure served two purposes, for by building sculptural "fins" from the outboard bulkheads inwards at the necessary intervals it was possible both to disguise the soil pipes and to form bays. These



The centre of the Peacock Room showing the unusual treatment of the ceiling



Tourist-class restaurant showing the "fins" used to create bays

bays divide the seating in this enormous dining-room which is, incidentally, the largest afloat seating some 750 people at a sitting. Like most dining saloons it is well down in the ship, and consequently the ceiling is of minimum height, which I have emphasised outboard by making the white ceiling curve almost to the sides where there is a dark margin. In the centre of the room the ceiling is of brightly lit glass fibre, and appears higher. All the bulkheads are panelled with irridescent greeny gold glass fibre; and the "fins", which are cut away in the centre so that you may see right across the vast room, are covered in white leather cloth. The floor is dark blue rubber and all the wood used for the furniture is M'ninga.

Apart from designing rooms for special interests and round the hazards of plumbing, a third way to get legitimate variation is to work with artists. By this I mean working with a painter or sculptor from the planning stage of the room so that with your different points of view, you may influence and bounce off each other to produce something individual. Most artists are willing to work this way and are glad of the greater scope for their work, and I think that the consequent widening of one's own vision as a designer is extremely valuable. Examples of this method of working are to be found in the already-described Peacock Room, where as a result of curving the walls and the depth of the blue, the sculptor worked in the reverse direction (rectangular and white) as a contrast.

The Island Room, which is to be used for concerts, games, dances and even as a children's playground at times, opens right up down each side in good weather. All the remaining walls are covered by a vast and highly coloured mural by Robert Buhler, R.A., of Ceylon and the Pacific Islands. The painting was made on specially treated paper which was then laminated into plastic to make the wall panels. All the mural paintings in the tourist class are treated in this way, so as to be washable and virtually indestructible. Down each side of the room are seat screens which swing at right angles so as to divide the room athwartships when needed. Little else was needed to decorate the room, so the furniture—again of bent plywood construction—is laid out in islands on white Indian rugs; the layout being variable according to the positions of the screens.

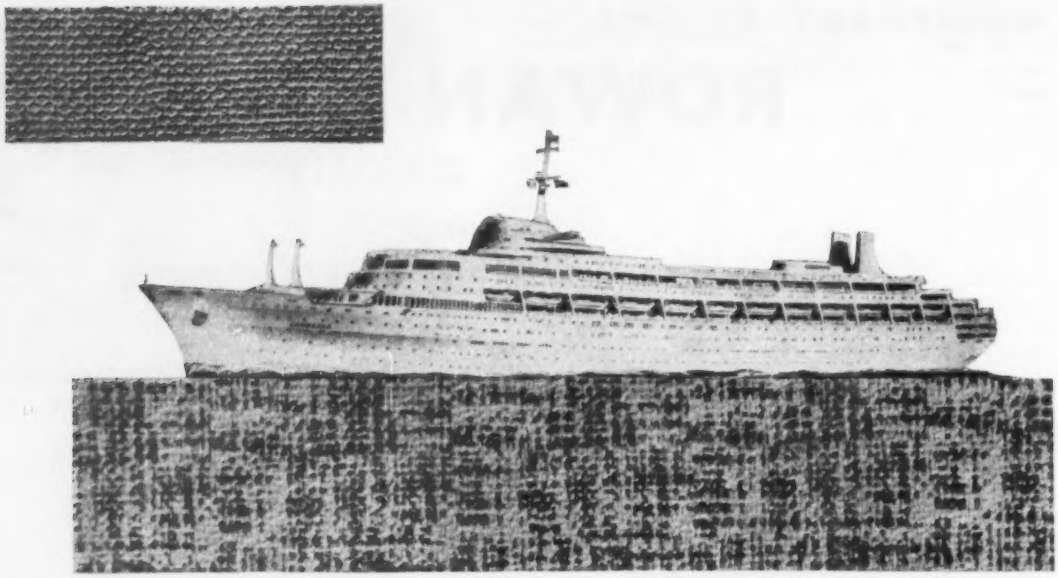
The second space which has been virtually taken over by the artist is the Pop Inn, where I wanted to get over the problem of the indestructibility of the walls without using rather unsympathetic plastic. I therefore had the idea that they should be destructible; and that the best way to encourage this without destroying the look of the room was to put up ordinary Deal panelling, and to burn into it with a hot poker drawings and designs, literally all over, so that any subsequent efforts would be lost. A student of the Royal College of Art, using a calor-gas powered soldering iron, has carried out this monumental feat. The room is intended for teenagers, and is on the lines of a coffee bar with a "juke-box" and hot and cold drink machines. There is space either for dancing or for playing table tennis, and a small sitting-out room. The bar tops are made of hundreds of strips of coloured plastic used edge on, and by the same method lit panels have been made for the sitting-out room. The furniture is covered in nylon fur, and part of the lighting for the room is from a multicoloured "scribble" of neon tubing in the ceiling.

There are tremendous arguments among designers about the use of colour. Some are for monotones and some use a lot of colour. The former theory supposes that people in their dress and movement provide enough colour to the eye, so that further background colour is merely muddling. However, I feel that each room should have a life of its own, and that it is pleasant to add yourself to such a room, and that it is even better to have a choice. This is particularly so when you are at sea and perhaps in need of refreshment for the eye.

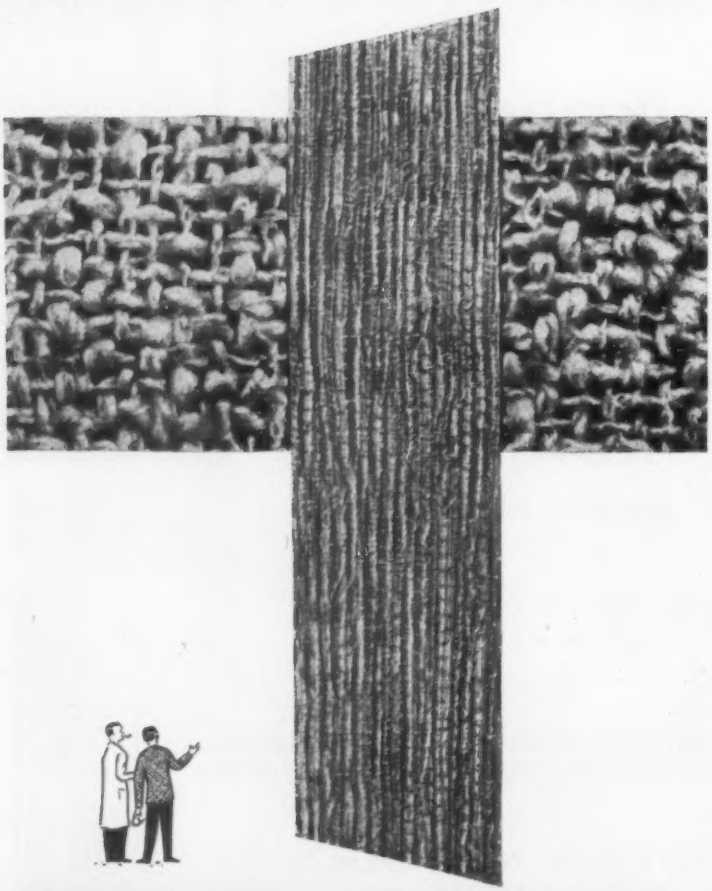
I think children are particularly attracted to colour, and in the *Canberra* the playrooms in both classes are brightly coloured and in no way "schemed."

Very special design problems are the swimming pools and the bars in a ship. The solid drinking atmosphere of the local cannot quite be lifted, as ship bars do not work quite in the same way. I felt one could not go far wrong with cricket as a main theme in the *Canberra*. So the Cricketers Tavern is the main bar in the tourist class, and we called in last year's England captain as a consultant. It is a long and narrow room, with curved

Main section of the tourist-class restaurant



Mural Texturide in the 'CANBERRA'



Arlington Plastics Development Ltd., are proud that Mural Texturide vinyl wall covering was among the materials specified for the internal decoration of the 'Canberra'. Mural Texturide was used for wall covering in the Senior Officers cabins and for ceiling covering in the first class bathrooms.

Mural Texturide found its sea legs a long time ago, and many miles have now been specified by marine architects and designers for ships large and small, from P. & O, Orient Line's 'Canberra', Canadian Pacific's Flagship 'Empress of Canada', Royal Mail Line's 'Amazon', 'Aragon' and 'Arlanza' down to cross-channel packets and private cruisers.

No other surface covering offers such beauty of texture, colour and design allied to great durability, for Mural Texturide's vinyl surface resists dirt, stains, burns, scuffing, ozone, and is completely washable. Maintenance is simple and there is no need for frequent re-decoration.

There is a wide range of colours and designs to suit almost any decor.

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seating (covered with leather and white stitched in rows at the joins) round tables, forming separate groups. The walls are all of willow strips, and painted on screens there are life-size portraits by Ruskin Spear, R.A., of four famous cricketers. The bar is made of willow and white marble and has a hand-hold wound round like a bat handle with black twine. Hanging behind the bar are more than two hundred ties representing famous clubs.

There are two pools, the Lido and the Alice Springs. The Lido is high up, and includes a sunbathing deck and an adjoining paddling pool for chidren which will be supervised by "nannies". This pool has been decorated in coloured mosaics by Edward Bawden in abstract designs, and in the paddling pool as a garden landscape.

Alice Springs includes a bar and café which is under cover, and the whole is decorated in a feather-like motif in multi-coloured glass mosaics by Arnold Machin, and is rather more sophisticated than the other pool area. All the furniture and the bar front is of cane, some of the seating being hung from flat supporting columns.

I believe that in the *Canberra* the designs we have made are very English in character: you will find no Continental gimmicks nor any consciously borrowed ideas. English ships should be English. Shipping is a field in which we have had long experience and our traditions are based on sound ideas. It remains for us as a seafaring nation to re-apply the original theories to modern needs and techniques, with the confidence of which we are capable.

Cabins for Passengers and Crew

By BARBARA G. OAKLEY

THE P & O-Orient Line aims to provide a very varied service between Great Britain and Australia and across the Pacific, to take people in comfort and with amusements, travelling on business or cruising for pleasure. To do all this and keep the ship as full as possible under all conditions meant evolving a very flexible form of accommodation, and this is what the owners and their team of designers headed by John West have succeeded in doing.

There are, broadly speaking, six different groups of passenger cabins. All tourist and some grades of first-class cabins have upper berths which fold away against a matching bulkhead, leaving the maximum room clear in the day time. Most are so easy to operate that even a frail female can do this for herself if she does not feel inclined to ring for the steward. Heaton Tabb & Co Ltd did much experimental work on these before they could be made to work smoothly in all circumstances. This firm also made the prefabricated glass fibre shower and WC units and wash basin recesses. The showers with cylindrical perspex screens were designed by John West, and it is largely due to their compact shape and lightness that it has been possible to provide showers in so many tourist cabins. Naturally there are showers or bathrooms attached to all first-class cabins.

One of the bugbears of all designers who work in ships is the surface accessories—that is the air-distributors, loudspeakers, thermostats and surface wired electric light points. Weight and cost, as well as space, make double bulkheads everywhere out of the question; so, although there are soundproof bulkheads between all first-class cabins, one of our main conundrums has been how to clean up both bulkheads and deckheads, and a great deal of work has been done by Thermotank, Tannoy and the builders, as well as by the owners' team. Success may not have been as complete as we would have liked in all groups of cabins, but at any rate there are some encouraging results.

To achieve the maximum comfort in what must inevitably be a very small space has been one of the most difficult and interesting problems. Every available inch has been put into wardrobes and storage space and, in the circumstances, clean unfussy lines become a practical necessity as much as an aesthetic desirability. Large frameless mirrors help to give an impression of depth, and white and pale coloured bulkheads have been used to keep most of the cabins looking as large as possible. Obviously, furniture for thousands has nowadays to be mass-produced. At the same time sizes and shapes of cabins vary, and no one wants useless gaps of a few inches, too small for a suitcase and difficult to clean. So in each group of cabins a common denominator had to be found for each dressing table, writing table, and so on. In average tourist cabins there was no room for a cot if parents had a baby with them, so in certain cabins the dressing table has been fixed on a runner and can be pushed to one side and fixed in an asymmetrical position when necessary.

In first-class shower cabins the dressing table, writing table and small nest of drawers can be fitted into a minimum space, or spread out, with a continuous top linking them all together and still giving a tailor-made appearance. In order to avoid a "working top" impression, the hard plastic used for some of these is an exclusive pen and ink design by Joan Hope on a white background, and in some others a dark blue and green cotton by Jacqmar has been laminated in plastic by Perstorp. So that face cream and skin tonics will not slide about, wells of glass fibre are let into the surface for their safe storage. Dressing table drawers are also lined with glass fibre trays which are very easy to clean and thus save the constant labour and expense of new lining paper for every trip.

The bulkheads of first-class cabins are covered with Vynide, a soft plastic with a texture something like linen. A large proportion of white has been used, with dark

Two-berth tourist-class cabin. The upper berth has been folded away

A two-berth first-class cabin, arranged for day use

charcoal carpets which are close fitted. Simple grained woods, deep colours and occasional bright high lights have been planned, in the hope that passengers will feel the atmosphere is restful without being dull.

The largest proportion of first-class accommodation is arranged in groups looking on to "courts" which have three large windows in the ship's side. Thus, even though insulated from the elements by air conditioning and double stabilisers, anyone can look out and judge the weather for himself.

Each room has a control panel for radio, temperature, two-way light switches, and service telephone.

Luggage space is provided either under wardrobes or beds, and in most cases beds can be made into comfortable settees, either by an adjustable platform or by the addition of fitted bolsters along one side. Where there is no convenient place for a conventional bedside table, a drawer under the bed has divisions for books, sleeping pills, and other oddments, and a sliding top for early morning tea trays.

A difficulty has been to fit convenient furniture into the radiused outline of forward decks and it was necessary to design another group of furniture, on the same principles as the rest of the accommodation but of different proportions and capable of different combinations. In these forward cabins one bulkhead slopes inwards so curtains were not practical. Instead, we have pleated white Accordo blinds and white shutters against a pale lavender Vynide as wall covering.

For those who want more space and luxury, there are eight "de luxe" cabins and four "Veranda" cabins. In these rooms the beds fold away and there is ample room for a settee and easy chairs. There is a built-in television set, larger radio, a refrigerator and for the industrious, an ample writing table and extra telephone.

Officers' and Crew

Senior officers, who have considerable entertaining to do, have individual schemes and their furniture is designed to give as light an effect as possible. Refrigerators and television sets are incorporated in a general scheme of bookshelves, cupboards and drawers. Danish woollen fabrics are used on upholstered chairs, and deep coloured close fitted carpets make the rooms really comfortable.

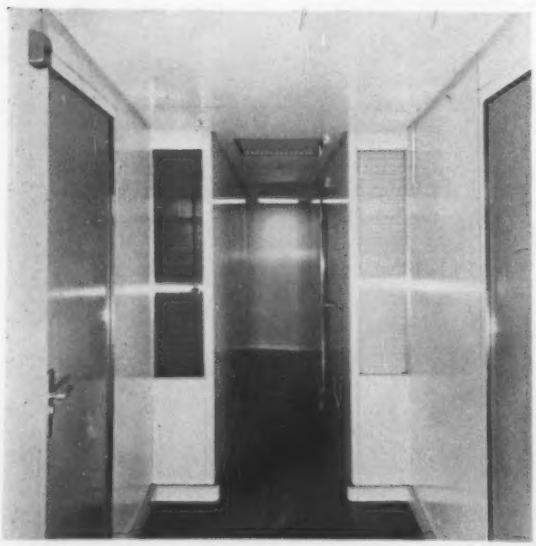
Furniture for junior officers has been designed on the same principles as for passengers, and is very simple but provides good storage space. The bulkheads are white Vynide and on the lavender-grey linoleum deck there are large charcoal coloured carpets. The beds and easy chairs are covered in a very heavy closely woven cotton in pink, scarlet and plum coloured stripes. This was specially developed for us by Donald Bros.

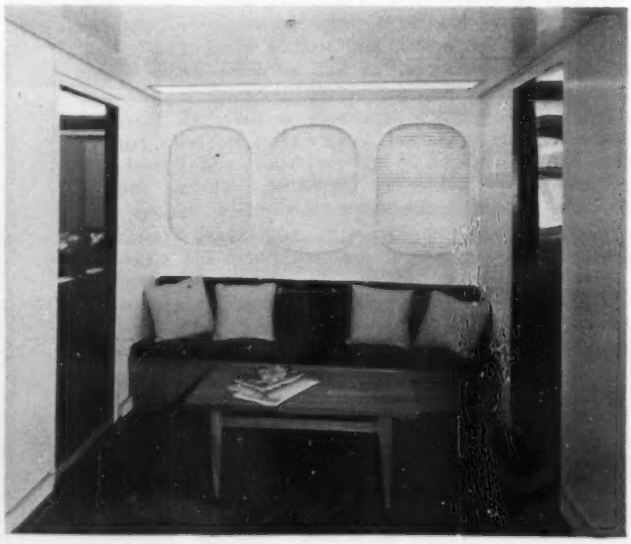
The officers' smokeroom is panelled in larch, and here they can watch television, play darts, have a drink or a game of cards. Full length midnight-blue and navy-blue check curtains run across one side of the room and the chairs are midnight blue and emerald green wool. Leading hands and crew have recreation rooms with the same facilities, and cool coloured plastic bulkheads make a less sophisticated background for strong coloured chairs and tables.

European stewards will eat in a mess room which is pale grey, black and red. They have boxes of green plants to break the square lines of tables and chairs, and transparent glass fibre screens with abstract designs by Allan Day run along the whole of one side.

Goanese stewards have a large room for mess and recreational purposes. The background colour for plastic bulkheads is grey, but in the mess room side there are two large panels of a gay orange print laminated in plastic, and on the recreation side the same print is used for curtains. Bookcases, writing tables and an altar are all veneered in straight grained elm and the screens across the side lights are a translucent blue glass fibre.

Many cabins are grouped round central courtyards as shown below. The left-hand view shows the windows in the cabins looking towards the sea, and the other shows the end of the courtyard with its large portholes

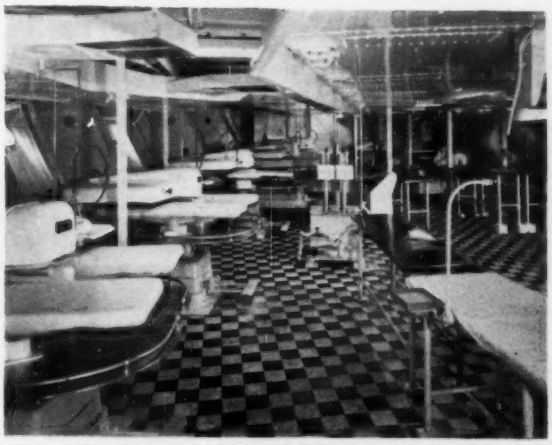




The Catering Side

THE *Canberra* has a total complement (passengers and crew) of 3,200—as many as would be represented by a small township. Catering for so large a number of people presents considerable problems, and everything has had to be planned for economy in space and time. The main galley is on the same deck as the two passenger restaurants, with the first-class dining room immediately forward and the tourist-class dining room immediately aft. The whole of the midships section of E Deck is set aside for the galley, which is 150ft long and extends the full width of the ship (100ft). The fish preparing room, bakery and butcher's shop are situated on the deck below, and are connected by lifts to the main kitchens. The confectionery shop, still room and cold pantries are all within the main kitchen area.

The galley, main pantries and service pantries are



ABOVE: Part of the laundry
LEFT: The first-class end of the galley, which extends the full width of the ship

equipped with the latest designs of electrically-heated and steam-heated stainless steel cooking apparatus. The equipment includes ovens, grills, fryers, bakers' ovens, hot-presses, salamanders, hotplates and toasters, as well as ice-making machines, potato peelers, dough mixers and dishwashing machines, often in considerable numbers. One firm alone—The Hobart Manufacturing Co Ltd—has supplied six fully-automatic and 18 semi-automatic dishwashers, 17 glass washers, two combination mincers and bowl cutters, five gravity feed slicers, five mixing machines, two mincing machines, three potato peelers, a power pastry roller and an electric meat saw.

Of the crew of about 960, a total of 717 are attached to the catering department. Restaurant stewards number 158. In the first-class dining room (seating 334) there is one steward to every six passengers; in the tourist-class dining room (seating 704) the ratio is one to eight. With a full passenger list, there are two sittings for all meals. The chef's staff number 114, and these include 21 bakers, 11 butchers, 11 storekeepers, second chefs, scullions and pantry men and boys.

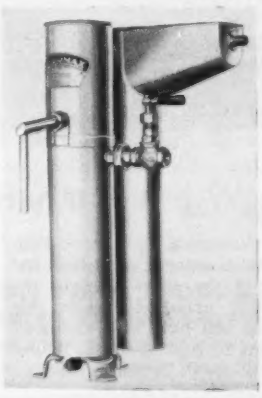
Laundry and Launderettes

The main laundry in the *Canberra* is large enough to handle 120,000 articles a day. In addition, the ship has launderettes, similar to those ashore, for passengers' own use. It is believed to be the first time that these have been provided in a passenger ship. A small self-service launderette is available on almost every deck in both first and tourist classes. These launderettes are equipped with suitable domestic-type washing and spin drying machines, and there are also airing and ironing facilities. The main laundry is equipped throughout with the most modern machinery, specially designed for the various phases through which the work has to flow—washing machines, hydro extractors, flatwork ironer, drying tumblers, shirt presses, general purpose presses, garment presses, collar finishing plant, ironing and finishing equipment.

Hundreds of tons of water are used each day in the laundry. Most of the rinse water is collected, processed, and sterilised for further use. This feature represents a saving of about 100 tons of fresh water each day.

CALOMAX BOILERS USED

TO MEET the stringent specification and high standards required for the *Canberra*, P. & O.-Orient Lines decided to install the latest type Calomax patent boilers to provide a constant supply of fresh boiling water on demand throughout the ship in pantries, for cabin, saloon and deck services, with similar arrangements to serve mess-room and galleys.



These boilers ensure a prompt service to any part of the ship at all times, with the advantages of hygienic operating conditions and the elimination of excess vapour and humidity. Prevention of condensation damage to decorations and structure was an important consideration, as was also that of space saving.

New patented features of the Calomax units provide a continuity of operation with facilities for simple and negligible maintenance.

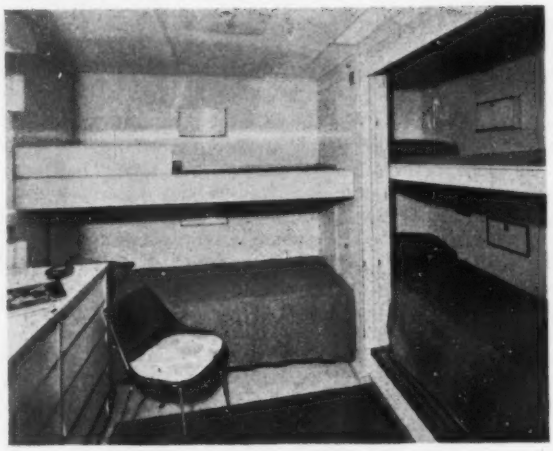
Plastics in the "Canberra"

EVERY modern passenger liner makes extensive use of plastics, and the *Canberra* is a good example of this. In the accommodation, plastic surfaces reduce the need for painting to a minimum. The first-class passenger accommodation and that for officers has vinyl plastic surfaces, while for tourist-class spaces and for the crew, a hard melamine plastic is used. Fitted ceilings are used in all cabins, and these also have a plastic surface. Resin-bonded glass fibre is used in cabins for the prefabricated shower and toilet compartments, with an ingenious cylindrical perspex screen, and also for the wash basin recesses. It is also used for the very comfortable chairs in the Meridian Room supplied by Lurashell Ltd.

About 1,250,000 sq ft of the Swedish melamine laminate, Perstorp, have been used in the ship. This is believed to be the largest single order ever placed for plastic laminate to be used in a ship. It has been employed on every kind of surface in cabins and alleyways, bathrooms, toilets, nurseries, galleys and on doors. Post-forming grade Perstorp has been used extensively for corners, where it has been applied to both plywood and Marinite cores at a $\frac{1}{4}$-in external radius, the height of the corners being 8ft and 9ft. Skirtings were also provided for use in conjunction with these corners.

In addition to the bulkheading material, Heaton Tabb have supplied 1,900 cabin doors, most of them faced with Perstorp in various colours. In all, Heaton Tabb bonded more than 22,000 panels, faced on one and two sides.

In the tourist-class cabins, 142 convertible units were specially designed by Heaton Tabb in conjunction with the owners, each unit giving a choice of either two additional berths or separate shower and WC. The internal bulkheads of these units are all faced in a light blue mottled Perstorp specially produced for the ship by the manufacturers of Perstorp, Skanska Attikfabriken.



One of the convertible cabins. Two of the berths can be replaced by a shower and toilet

For the tourist-class dance space, one of the largest plasticised murals ever fitted on board ship contains approximately 90 full-sized mural panels. The artist was Robert Buhler, working for John Wright, the architect responsible for the tourist class public spaces. The panels were painted on impregnated paper provided by Perstorp and the paper was then returned to Sweden for processing into finished panels.

A process for incorporating fabrics into plastic panels has been used for surfacing dressing table tops in some of the first-class cabins. Miss Barbara Oakley, who was responsible for the décor and furnishing of the first-class cabins, used a Jacqmar printed cotton which was laminated into Perstorp panels. The design is dark blue with turquoise daisy heads. Another design, incorporating black and white grasses and insects, was designed by Joan Hope. A special photogravure roller was produced by Perstorp to carry out the printing of this design.

Arlington Plastics Development Ltd has supplied Mural Texturide for the wall covering in senior officers' cabins, and also for first-class private bathrooms. This material, which has now been supplied to ships ranging from the *Queen Mary* to the *Empress of Canada*, is a vinyl-coated fabric. It is resistant to stains, burns, scuffing, ozone and sea water, and is completely washable.

The Captain's dayroom

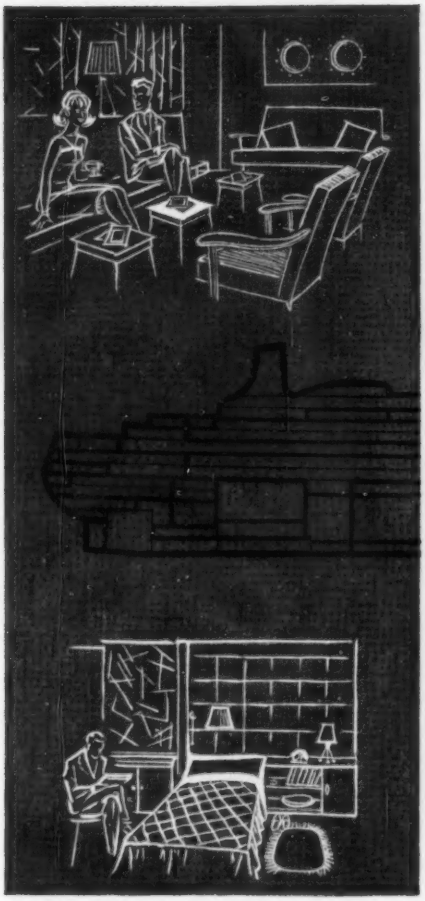
IN BRIEF

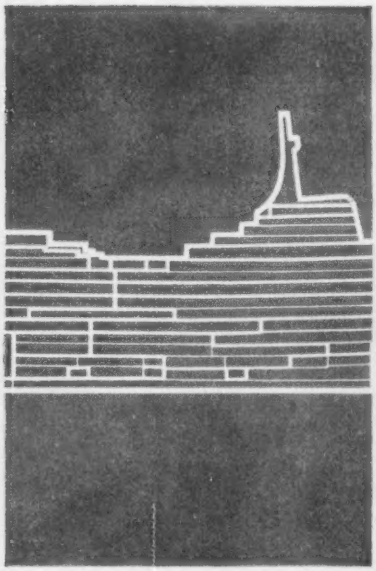
ALL THE MATTRESSES in the ship, numbering 3,250, have been supplied by Dunlopillo. Besides the mattresses, this firm has also supplied a large proportion of the foam used in the upholstery. The cinema is entirely upholstered with this material, while the De Luxe cabins will have easy chairs of the same material, and also cushions to convert the beds into settees for daytime use.

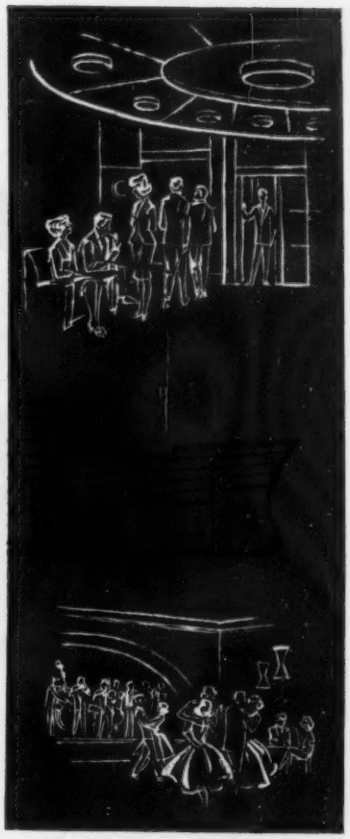
A TOTAL of 177 clocks are fitted throughout the vessel, and controlled from a master control panel.

WARDROBE DOORS and furniture for the first-class cabins were supplied by Shapland & Petter Ltd, of Barnstaple. They are faced with a variety of plastics and wood veneers, the latter including cherry, French walnut, Australian walnut and teak. Great care was taken in the matching of the veneers to ensure that the same figuring appeared throughout each cabin.

Two telephone systems are fitted, one automatic and one manual. The automatic system serves the officers', engineers' and crew's quarters, and the manual exchange of 700 lines serves the first-class passenger accommodation.







1,250,000 SQUARE FEET OF *Swedish* PERSTORP

is used in the new **CANBERRA** (45,000 TONS)

built for P & O—Orient Line by Harland and Wolff Limited, Belfast

Original ideas and advantageous materials combine to make Canberra unequalled for years to come. High on the list of materials used in her interior is Swedish Perstorp, the original plastic laminate. Giving a splendid glow of colour and freshness to Canberra's public rooms and alleyways, her 1st class courts, her tourist cabins, public bathrooms and toilets is Swedish Perstorp, a total of 1,250,000 square feet.

Perstorp economy pushes maintenance cost down and decorative standards up, enhances every surface, vertical, horizontal, curved or flat. Swedish Perstorp has also been chosen for use in ORIANA and many other vessels in the P. & O. Company's group building programme as well as for CANBERRA herself. Long-lasting and beautifully colourful Swedish Perstorp enhances decor and design; advances maintenance saving of great ships throughout the world.

Skånska Ättikfabriken AB, of Perstorp, Sweden, have been manufacturing plastic laminates for the markets of the world for over 35 years.

Sole Marine Agents for the United Kingdom

HEATON TABB & CO. LTD., * Adelphi Works

Cobbold Road, Willesden, London. Also at Liverpool and Belfast

**who supplied and fabricated all the plywood based Perstorp panels both flat and shaped, as well as nearly 2000 plastic faced cabin doors.*

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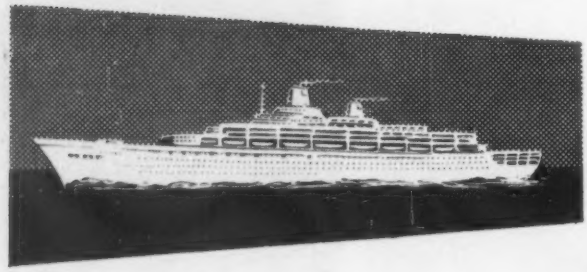
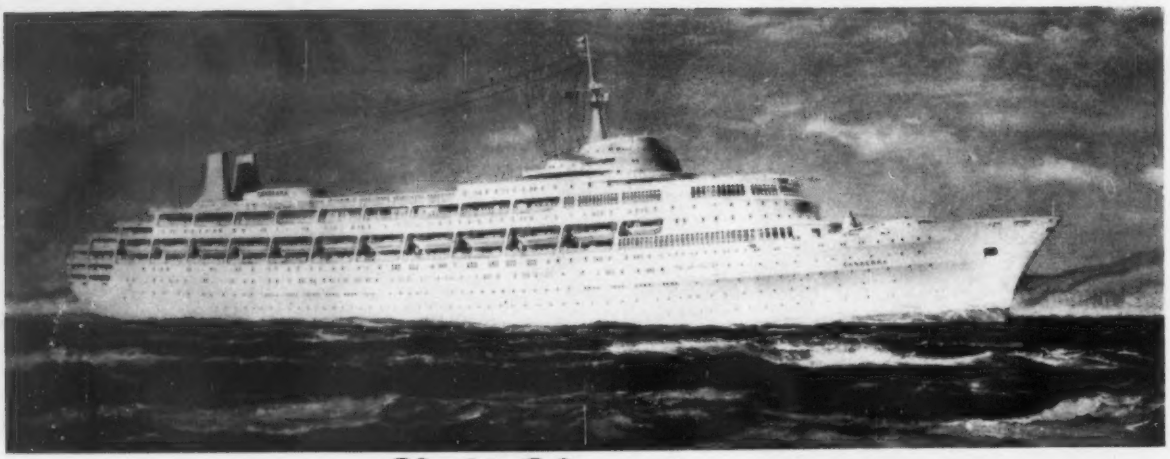


ORIANA

AND NOW

CANBERRA!



S.S. Canberra

COMPLETE HULL PROTECTION

using **HANGERS** *New* **MARINE PAINTS**

Following its successful use on S.S. ORIANA, HANGERS EPOXIDE PAINT SYSTEM, giving a hard, smooth, underwater surface, was again chosen by the P. & O. Orient Lines Management to provide complete protection to the hull of S.S. CANBERRA.

EPISOLVE—The REVOLUTIONARY SOLVENTLESS EPOXIDE. Bare patches produced by late engineering work were effectively brought forward with EPISOLVE, which gives an equivalent film thickness of 4 or 5 coats of normal paint in ONE APPLICATION—a valuable product for all marine work, particularly TANK LINING.

Hangers technical specialists are available to discuss your problems. Write to:—

HANGERS PAINTS LTD.,
MARINE DIVISION and WEBSTERS LTD.,
STONEFERRY WORKS, HULL
Telephone: 42111

Painting the "Canberra"

Use of Epoxide Paints

THE HULL of the *Canberra* has been painted with epoxide synthetic resin paint, as was that of the *Oriana*. In each case the paint was supplied by Hangers Paints Ltd. The treatment of the metal before painting was also similar

Seen in dock, the bulbous bow shows the good paint finish obtained. The aperture for the bow propeller is noticeable

for the two ships. For the hull of the *Canberra*, the treatment before launching was as follows:

1. Plates were chemically pickled before fitting and allowed to weather freely during the period of building.
2. The hull was vigorously cleaned by mechanically wire brushing to an agreed standard of finish.
3. Severe irregularities of welds etc, were abraded off or filled.
4. One coat of Hangers Metasol No 4 was applied, followed quickly by one coat of Hangers Anti-corrosive Epoxide Metal Primer and three coats of Hangers Anti-corrosive Epoxide Enamel to give a total film thickness of at least 125 microns (0.005in). In fact a minimum film thickness of 150 microns (0.006in) was obtained.
5. One coat of a temporary anti-fouling composition designed to prevent the typical fouling of Belfast Lough during the fitting out period of one year, but to be washed away by the end of that period, was applied.

The system for treatment in drydock to remove any remaining anti-fouling composition is to bring forward bare patches resulting from electric cutting operations, welding etc, and to apply to the whole surface one coat of Hangers Anti-corrosive Epoxide Enamel.

The process of "bringing forward" is—

1. Clean the bare metal by shot blasting or wire brushing as appropriate.
2. Apply one coat of Hangers Metasol No 4 and after one hour—
3. Apply one coat of Hangers Epoxide Anti-corrosive Primer.
4. Apply one coat of Hangers Episolve Enamel.

"Episolve" is a solvent-free epoxide-based material which gives in a single application a coating of at least 75 microns (0.003in) and can give single coatings of 200 microns (0.008in) thickness. It can be applied by brush, roller, or spray, giving coatings which will not sag, even at the great thicknesses mentioned. It hardens rather more slowly than Hangers Epoxide Enamel, but can continue to cure under water and can be safely immersed once a certain limited degree of cure has been achieved. Similarly, because there is no volatile solvent involved one coat can be followed by another before curing is complete. This is a valuable feature for drydock work.

The stern areas, stabiliser compartments, intakes, scoops etc, were given special treatment involving the use of two coats of Hangers Epicarb. This is a pitch epoxide composition with a low volatile solvent content, giving thick films in single coats. Its use results in a tough hard film resistant to turbulence and with exceptionally high electrical resistance which controls corrosion currents in the vicinity of dissimilar metals.

There were certain important respects in which the protection of the hull of the *Canberra* differed from that of the *Oriana*. These were principally:

1. The plating carried a more copious deposit of rust but did not carry the layer of mineral oil which was applied to the *Oriana* hull during building.
2. Painting had to be carried out in winter, whereas *Oriana* was painted during the hot, dry summer of 1959.

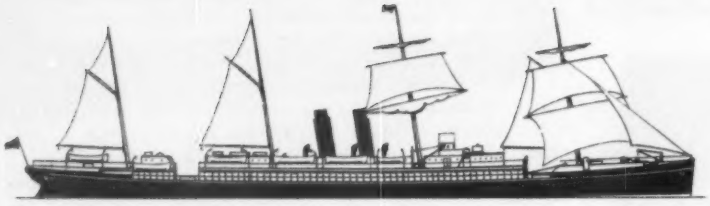
The danger from the copious rust deposit was that residual rust, inevitably left after cleaning, might still contain dangerous amounts of aggressive soluble salts. Samples of rust were therefore carefully analysed and were found to contain quantities of soluble aggressive materials well below the danger limit. Special treatments had been prepared in case the threshold were exceeded, but these were not needed. Furthermore because mineral oil had not been used on the plates, the danger of poor adhesion from this cause was not present and degreasing was not necessary.

DURITE cable-fixing trays in mild steel, ranging in width from 2in to 36in, have been supplied by Lockers (Metal Perforators) Ltd, Warrington, for the electric wiring in the ship.

A leading hand's cabin

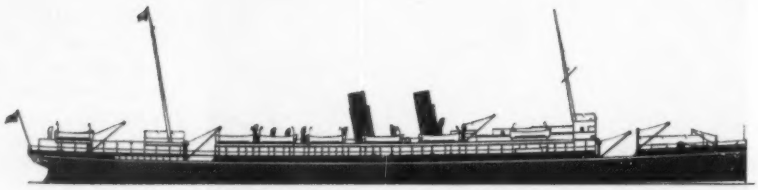
P & O Passenger Liners

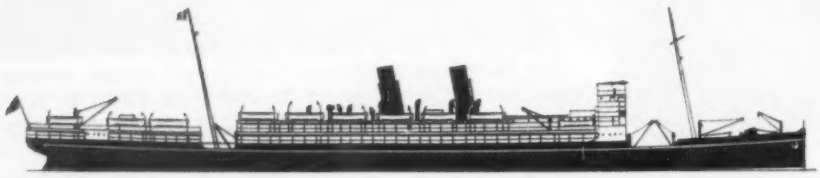
A SERIES OF DRAWINGS BY LAURENCE DUNN, ALL TO A



1887/8—The four "Jubilee" class, "Victoria", "Britannia", "Oceana" and "Arcadia", were built by Cairds of Greenock and Harland & Wolff Ltd, Belfast. They had a gross tonnage of about 6,150 tons and had accommodation for 400 passengers. Their triple-expansion steam machinery developed 7,000 hp and provided a service speed of 15 knots

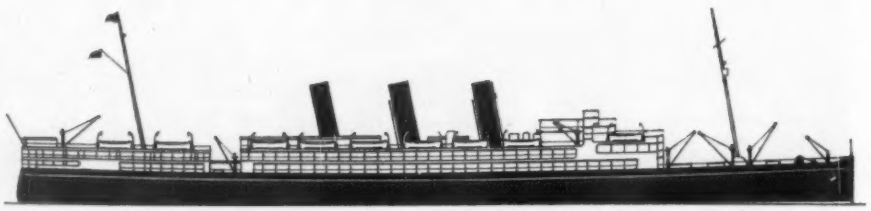
1896—The "China" was one of five similar ships built between 1896 and 1900. With accommodation for 480 passengers, the "China" had a tonnage of 7,912 grt. Her triple-expansion steam machinery developed 11,000 hp. She was built by Harland & Wolff Ltd, Belfast

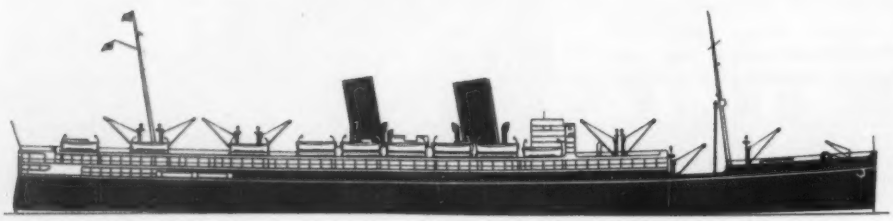




1908—The "Malwa", 10,883 grt, and her sister ship "Mantua" were members of the famous "M" class of liners built between 1903 and 1911. They had two sets of quadruple-expansion steam engines developing 13,000 hp and could reach 18 knots. Built by Cairds of Greenock, the "Malwa" could accommodate 607 passengers

1918—The "Naldera", 16,088 grt, actually entered service in 1920. An enlargement of the "M" class, she had accommodation for 674 passengers and had a service speed of 17½ knots. Built by Cairds of Greenock, the quadruple-expansion engines produced 18,000 hp



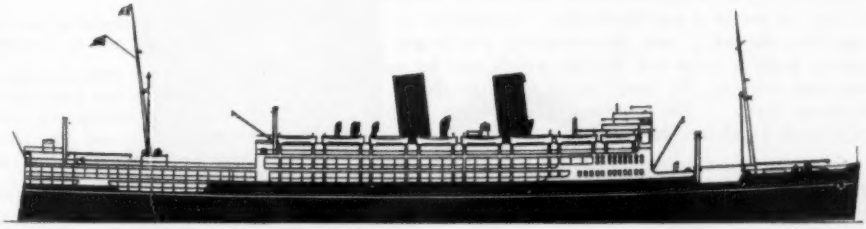


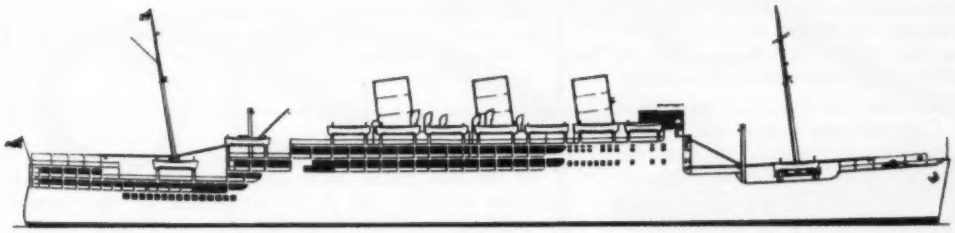
1923—"Mooltan", 20,952 grt, and her sister ship "Maloja" were built by Harland & Wolff Ltd, Belfast, and were the largest ships on the Australian run when built. Quadruple-expansion engines developing 16,000 hp gave them a speed of 17½ knots. Accommodation was provided for 656 passengers

of the Past and Present

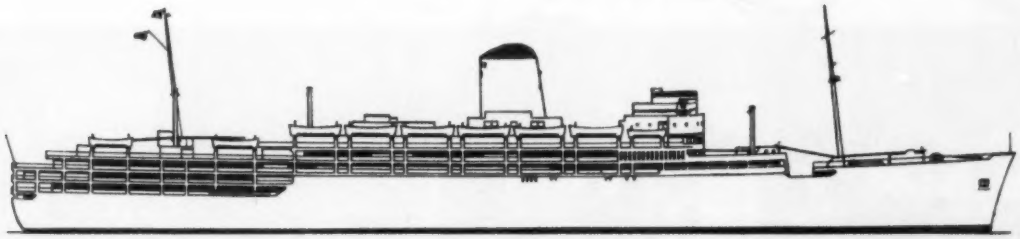
COMMON SCALE, OF REPRESENTATIVE SHIPS OF THE PAST 80 YEARS

1929—The "Viceroy of India", 19,648 grt, was the first turbo-electric liner in the fleet and one of the first in the world. Built by Alex. Stephen & Sons Ltd, she was mainly on the Bombay run and carried 673 passengers. The turbo-electric machinery developed 17,000 hp and gave her a speed of 19 knots

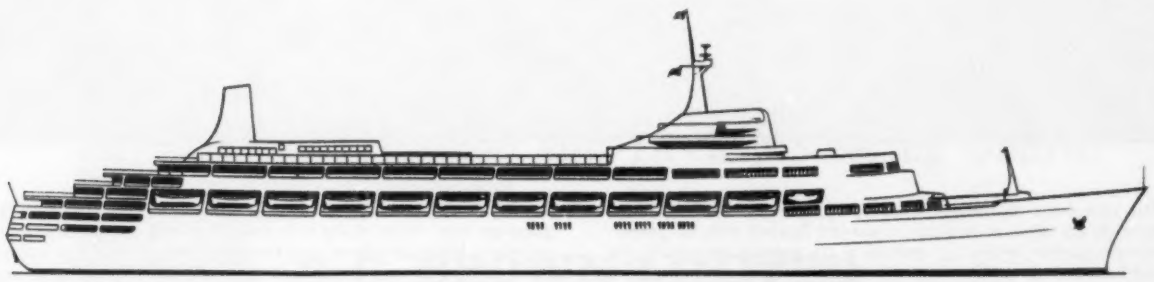




1931—The "Strathnaver" and her sister ship "Strathaird", built by Vickers-Armstrongs (Shipbuilders) Ltd, measured 22,270 grt and had accommodation for 1,168 passengers. The 28,000-hp turbo-electric machinery produced a speed of 23 knots



1953—John Brown & Co (Clydebank) Ltd built the 29,734 grt liner "Arcadia". Her geared turbine machinery has an output of 42,500 hp and she can maintain a service speed of 23 knots. Accommodation is provided for 1,414 passengers. A similar vessel of slightly lower tonnage, "Iberia", was built by Harland & Wolff Ltd, Belfast, in 1954. They were a development of the "Himalaya" and "Chusan" of 1948 and 1949



LAURENCE DUNN

1961—"Canberra", 45,000 grt, built by Harland & Wolff Ltd, Belfast, to operate in a complex round-world service together with "Oriana" of the Orient Line. For this vessel the company reverted to turbo-electric machinery of 68,000 hp. She can carry 2,250 passengers at a service speed of 27½ knots

NAVIGATION AND ELECTRONICS

RADAR INSTALLATION

THE RADAR INSTALLATION in the ship is as comprehensive as any at sea in a merchant ship. In addition it includes the first use of a new development, the bright display, which gives a large-size display which can be viewed in daylight without the need for a visor to shield it from external light. The equipment has been supplied by Kelvin & Hughes (Marine) Ltd.

Basically, the *Canberra* installation consists of two true motion radar systems, each complete with its own basic units and controls. There are two scanners, two transmitters, two display units, and two motor-alternator assemblies, with an additional slave display provided to work remotely off either of the master displays. The two systems are arranged so that they can be operated separately or simultaneously, and changeover switches enable any unit of either system to be used with units of the other system if required. This arrangement not only achieves valuable operational flexibility, but also allows routine maintenance service to be carried out with no interruption in availability of normal radar information.

The two master displays and the requisite operational controls are centred in a navigational bridge console also supplied by Kelvin & Hughes and specially designed for the *Canberra* in cooperation with the owners. Situated in the wheelhouse, this console is an integrated combination of tactical chart table, radar display systems, echo sounder, Decca Navigator, clock, logs, etc. It also serves as a housing for units concerned with the S. G. Brown autohelmsman, Kelvin-Hughes transmitting magnetic compass, bridge wiring to telegraph communication system and wheelhouse lighting control.

Of the two master radar displays situated in the navigational console, one is an adaptation of the normal Kelvin-Hughes Type 14/16P. This provides relative motion or true motion presentation on a 16-in P.P.I. display with built-in reflection plotter.

The other master display is a 24in diameter "bright display" offering either relative or true motion presenta-

NEW IDEAS

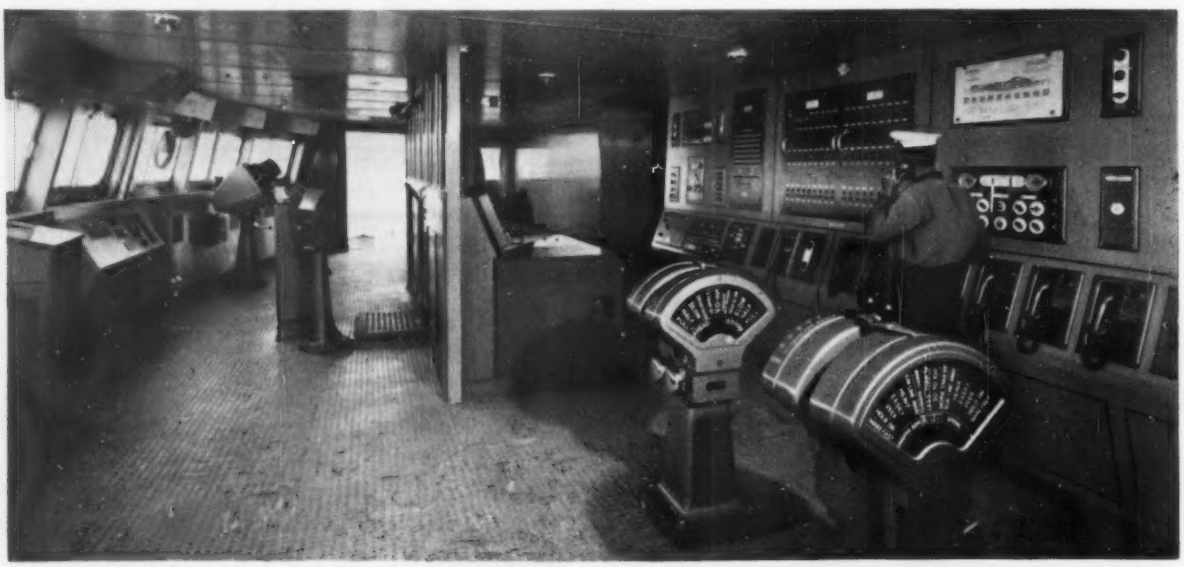
Radio, navigational and other electronic equipment in the "Canberra" includes a number of new developments.

The ship's radar installation—an unusually complete one with two complete sets and a third display unit—includes one display unit of an entirely new type in which a cathode ray tube is photographed and the resultant film projected on a screen, giving a bright image that can easily be seen in daylight.

The radio installation includes the use of single-sideband transmission for medium range radiotelephony—a development which offers the promise of doubling the number of channels available for communication. At present there are four Post Office shore stations equipped to work this new system.

The internal television system is of the type first used in the "Oriana," where it has proved very successful.

The steering control system employed is claimed to be the most comprehensive auto-electric steering control system in the world. The complete bridge steering unit is duplicated aft in the ship's heading, and contains a dial on which he can set the correct course to remind himself.



IN THE WHEELHOUSE

This view shows the general layout of equipment in the wheelhouse. Space for the officer of the watch is provided forward, with the quartermaster's position behind. In addition to the steering control unit, the quartermaster has in front of him the repeater unit from the transmitting magnetic compass, and the reflector from this compass projecting down from the deckhead. Separated from the forward part of the wheelhouse by a glass screen is the navigating console, containing two radar displays and their controls, Decca Navigator, echo sounding recorder and a working chart table—the first to be fitted on the wheelhouse in a P & O passenger liner. At the aft end of the wheelhouse is an instrument console containing bridge telephones, sprinkler alarm panels, fire alarm indicators, stabiliser controls, watertight door controls, internal broadcast control and other instruments. The telegraphs in the foreground are a docking telegraph, steering telegraph to after steering position, and a pair of engine order telegraphs. The bow propeller is controlled by push buttons in the centre of the wheelhouse front, and on either bridge wing

The bright display of the radar in use

tion. This large screen bright display is produced by use of a photographic rapid processing technique pioneered by Kelvin-Hughes for defence purposes, and now developed for marine radar application and installed in a ship for the first time in the *Canberra*. This equipment presents P.P.I. information by projecting on to a 24-in display surface a sequence of rapidly processed "photographs" of a special cathode ray tube. The time cycle between successively projected pictures can be varied between 3½ seconds and 60 seconds. This means that on the time cycle of 3½ seconds the information on the cathode ray tube is photographed, processed and projected to the plotting screen within 3½ seconds. By comparison, a conventional radar display using an aerial rotation of 20 rpm renews the radar data once every 3 seconds, so that there is a maximum possibility of 6½ seconds delay in the sighting of an echo. The projected image can be either black on white or white on black for daylight viewing, while a choice of coloured shades is provided for use at night. Apart from the obvious advantages of the large screen bright display achieved by this method of presentation, the photographic projector provides the ultimate in radar plotting facilities, since the P.P.I. image is projected on to a paper surface, and direct plotting becomes possible for the first time in the commercial history of radar.

The slave display is situated at the forward end of the wheelhouse, and can be a slave to either of the two master displays. It presents a 12-in relative motion P.P.I. display and has a reflection plotter.

The aerial system comprises two 10ft slotted waveguide scanners installed adjacent to each other on the mast just above the crow's nest. Despite the close proximity of the two scanners, both can be operated simultaneously without mutual interference. This has been made possible by a specially synchronised power supply system, which is itself duplicated to allow for continuity of operation during servicing periods.

COMPASSES AND STEERING

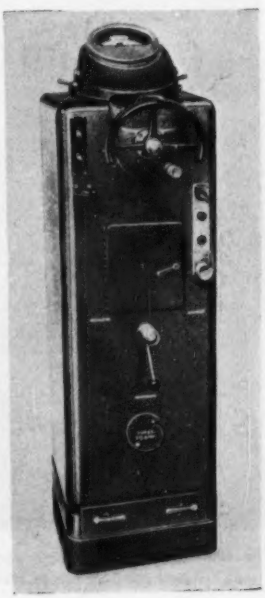
THE GYRO COMPASS and the steering control system fitted in the *Canberra* were supplied by S. G. Brown Ltd. The gyro compass is the new Arma-Brown compass which is notable for its very small size. It is installed in the chart room where it is fitted in the chart table, allowing the navigating officer to use the heading indicator built into the top of the compass. Compass repeaters are fitted in the two steering control units, on monkey's island, in the bridge wings and also in the captain's cabin, apart from the feeds necessary for radar stabilisation.

The steering control system is claimed to be the most comprehensive auto-electric system in the world. In addition to the normal control position in the wheelhouse, there is a complete duplicate control unit in the steering gear flat, which is connected to the wheelhouse by a helm order telegraph. With the Brown auto-electric steering control the steering unit has a small half-wheel for the quartermaster to turn, and this has only three positions corresponding respectively to "train left," "stop" and "train right." This is of course in complete contrast with the movement of a normal ship's wheel, where a certain rotation of the wheel produces a proportionate rotation of the rudder. Quartermasters who are accustomed to the usual method of steering take a little time to get used to the difference, but once they are familiar with it the new method is usually preferred.

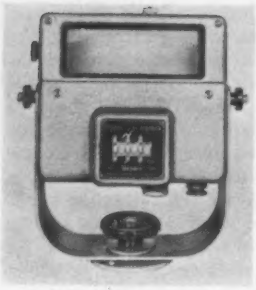
Three Methods of Control

The system provides three methods of steering control from a single wheelhouse unit. Rudder application is brought about by two S. G. Brown after power units which are directly coupled to the control valve of the steering gear, and which are primarily controlled from the single wheelhouse unit. With the electric steering control the only connection between the bridge and the steering gear consists of duplicated electric leads, and hydraulic piping from the steering engine, the wheelhouse telemotor transmitter and large wheel are not required.

Of the three methods of steering control provided by the main wheelhouse unit, the first is main (hand-electric) control by means of a hand wheel. Movement of the handwheel operates port or starboard switches, which in turn operate breaker switches. These breaker switches, situated in the wheelhouse unit, govern the operating field circuit in whichever after power unit is selected. The second is auto control by means of an automatic helmsman situated in the wheelhouse unit operated from a datum provided by the gyro compass. Finally there is secondary (hand-electric) control by means of a lever



The wheelhouse control unit for the S.G. Brown steering system. The lever for secondary control is immediately below and to the left of the main wheel



This compass repeater, installed in the captain's cabin, has a dial on which the course to be steamed is set manually

located on the front of the unit. When the lever is moved to port or starboard, switches are made which in turn operate a second system of breaker switches. These breaker switches govern the operating field circuit in the other after power unit to that selected for main or auto control.

Magnetic Compass

The standard compass is a Kelvin Hughes transmitting magnetic compass, which is installed on the roof of the wheelhouse and feeds information to a specially designed repeater at the steering position. The repeater reproduces a 30 deg sector of the compass card on a screen 8in wide, thus affording clear vision. The binnacle also incorporates a direct reflector unit as a secondary system.

TELEVISION ON BOARD

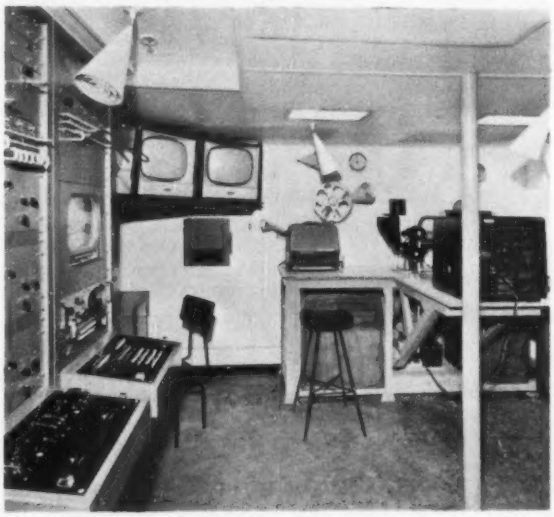
The television installation follows the pattern successfully inaugurated in the *Oriana*, which had the first seagoing system of its kind in the world. During the *Orian's* maiden voyage, B.B.C. television programmes were still being received quite clearly when the vessel was more than 150 miles from the U.K. coast, and this good reception continued in other parts of the world where television programmes were being transmitted. The *Canberra* is equipped with a similar installation providing a completely coordinated internal and off-air television service anywhere in the world.

Three Systems Received

The installation provides for the reception of television broadcasts employing the 405-line system used in Britain, the 625-line system used in Australia and the greater part of Europe, and the 525-line system used in the United States, Canada, Japan and some South American countries. Whatever alternative programmes are available, viewers will be able to change from one channel to another by using the normal channel selector switch on the receiver. Thus, while the ship is in the United Kingdom area, either B.B.C. or I.T.A. programmes can be selected at the receiver; and elsewhere the same switch will select any of the local stations operating in Bands I and III.

A major feature of the system is the use of standard proprietary receivers, the incoming broadcast programmes

The chartroom is immediately abaft the bridge. The Arma-Brown gyro compass can be seen beneath the chart table



In the television control room

being processed as appropriate in a central television control room adjacent to the radio office before distribution to the receivers. Initially, some 40 television receivers, with 17in, 21in or 24in screens will be used in public rooms and first-class cabins, but provision has been made for increasing the number to a maximum of 350 at a later date, without any alteration to the basic installation.

The processing equipment includes two Marconi Vidicon camera channels which also form part of the ship's closed-circuit installation. Each of the two camera channels is associated with a separate 16mm film projector and a separate slide projector.

Closed-circuit Film Programmes

On the high seas, out of range of television transmitters, passengers will be entertained by closed-circuit programmes mainly derived from a library of 16mm films; but the installation is very versatile—the cameras can be used to screen studio scenes, interviews and outside shots with no additional equipment. One of *Canberra's* public rooms has been wired for use as a television studio; a camera can be plugged in and used for plays, interviews and amateur shows produced by the liner's staff and passengers. Outside shots, particularly on the bridge, which is close to the television control room, will give passengers an insight into the duties carried out by the navigating officers without interference with the navigation or running of the vessel.

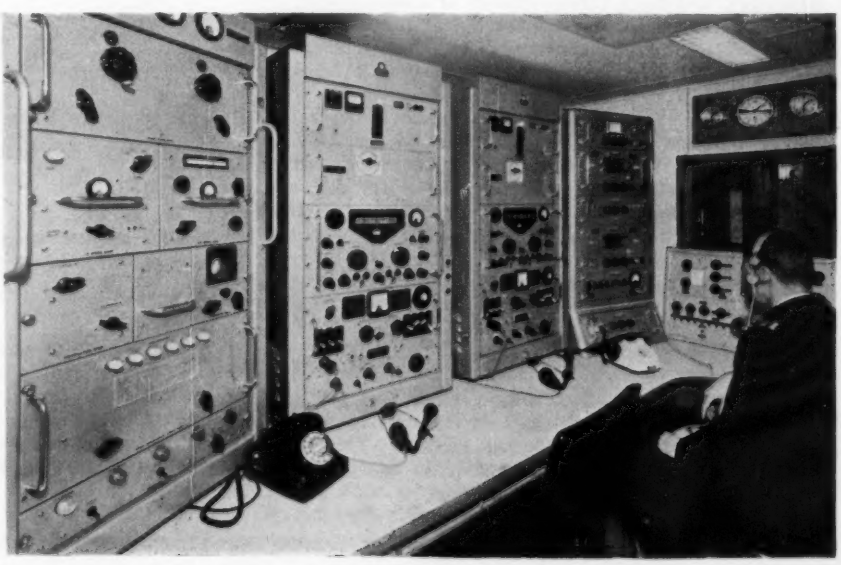
RADIO INSTALLATION

IN THE *Canberra*, The Marconi International Marine Communication Co Ltd has installed communications equipment and navigational aids similar to the installation which the company provided for the *Oriana*. On the radiotelephone side, the ship has a high-powered single-sideband transmitter, with two associated receivers and terminal rack equipment giving passengers and ships' officers facilities to make a long-distance radiotelephone call to anywhere in the world. Such a call is made with complete privacy through the use of speech inverters.

In the radio office

Telegraph traffic will be handled by a Globespan transmitter and three Atalanta receivers. This high-powered all-purpose transmitter can also be used for radiotelephone calls in addition to the main single-sideband installation. A Reliance transmitter, Alert receiver and an Autokey form the emergency installation in the radio office, and two of the *Canberra's* motor lifeboats contain Salvare emergency radio equipment, with powerful searchlights also operating from the battery supplies.

Marconi navigational equipment includes the new Lodestar automatic direction-finder, fitted in the radio room. Operational simplicity is the chief design feature of Lodestar; once tuned to a radio-beacon frequency the pointer automatically swings round to the true bearing with no other manual adjustments. A successful new method of presenting depth information is incorporated in the *Canberra's* bridge equipment. Called the Metron, it is a depth sounder display, and gives unambiguous indication by pointer of the depth of water below the vessel at any second. Working with the Seagraph III dry-paper recording echometer, the Metron employs a simple form of computer to differentiate between the true bottom echo and spurious re-echoes and interference.



In the radio telephone section of the radio office

INTERNAL BROADCAST SYSTEM

Shipboard broadcasts are provided through an internal broadcast system designed and supplied by Tannoy Marine Ltd, and loudspeakers in all cabins, including crew cabins, provide the means of receiving either of two programmes—radio or pre-recorded music and news, or programmes emanating from the ship's public rooms. If they wish, passengers can have continuous music in their cabins while the ship is at sea; the music is fed from tapes specially recorded and supplied by Reditune. Other music relayed in the ship is provided by gramophone records and tapes. Another unusual feature is that broadcasts can be fed into the ship's main transmitters for special relays, if required, from a small room in the first-class section of the ship which is available for use as a studio.

COMMERCIAL TELEVISION AT SEA

The contractor appointed by P & O-Orient Lines to provide entertainment material for the closed-circuit television programmes in the *Canberra* and *Oriana* is Programme Exchange Ltd, of London. On her maiden voyage last December, *Oriana* was supplied with a full complement of programmes. This voyage included approximately 80 closed-circuit transmission days. The results were so encouraging that it was decided to embark immediately on the second stage—the inclusion of commercial advertising—on future voyages. This commenced when the *Oriana* left Southampton on April 12 on her second voyage, and is being continued on the *Canberra's* maiden voyage. Eight minutes of commercial time is available on each transmission day during the adult entertainment period (between 9.30 p.m. and 11.0 p.m.). The commercial period is divided into two segments of 3 minutes and one segment of 2 minutes inserted at the commencement of transmissions and between programmes.

PIPE JOINTS in the domestic fresh water supply system in the ship are of the Kingley type supplied by the Kings Langley Engineering Co Ltd. These joints employ a swaging principle that prevents any possibility of them pulling off or working loose.

Mechanised Baggage Handling

SPECIAL EQUIPMENT FOR BAGGAGE AND STORES

A NOVEL system of mechanised baggage and stores handling is employed in the *Canberra*. It has been specially developed for the ship by J. Collis & Sons Ltd, the mechanical handling engineers. On a run as long as that to Australia passengers usually have a good deal of baggage, both for use on the voyage and for stowing in the baggage room. Baggage destined for passengers' cabins is normally handled by stewards with the aid of the passenger lifts, being carried into the ship by hand, while that destined for the baggage room is probably handled by the ship's derricks or cranes.

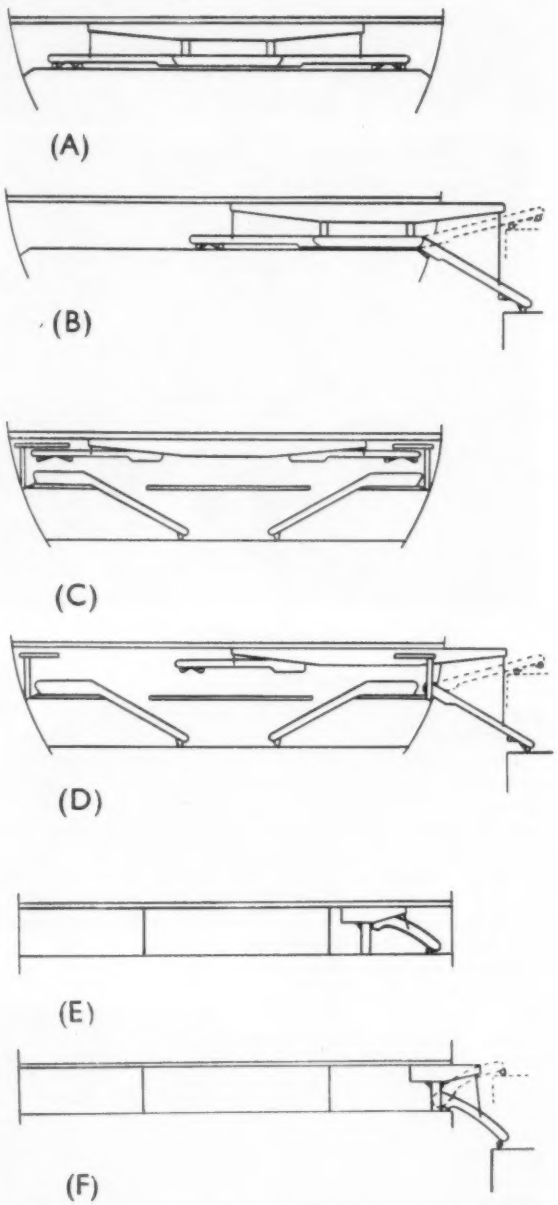
For the *Canberra*, J. Collis & Sons Ltd have designed a system of slat conveyors combined with an automatic baggage elevator which eliminates a great deal of the manual effort previously needed, with a consequent saving in time. They have also designed a slat conveyor installation to handle the ship's stores. Although designed specially for the ship, the equipment is based on components from the firm's range of mechanical handling equipment which has been used in industry for many years, and is therefore well proved in service.

The Collis equipment installed in the *Canberra* consists of entirely separate systems for handling baggage destined for the cabins and baggage destined for the baggage room. There are also rather similar, though simpler, conveyors for the handling of stores. In every case the conveyors are housed within the ship when at sea, and when in use are extended through doors in the ship's side until they bridge the gap between ship and quay. These side doors are on E Deck, quite low in the ship and their use reduces the distance that baggage and stores have to travel. There are eight openings, two aft on either side of the ship for baggage, and two forward on either side for stores. It is of interest that at the last Safety of Life at Sea Conference a proposal to restrict the number of such side openings in passenger liners was successfully opposed by the United Kingdom delegation on account of the promise which it felt these baggage handling systems offered.

Cross-deck Conveyor and Baggage Elevator

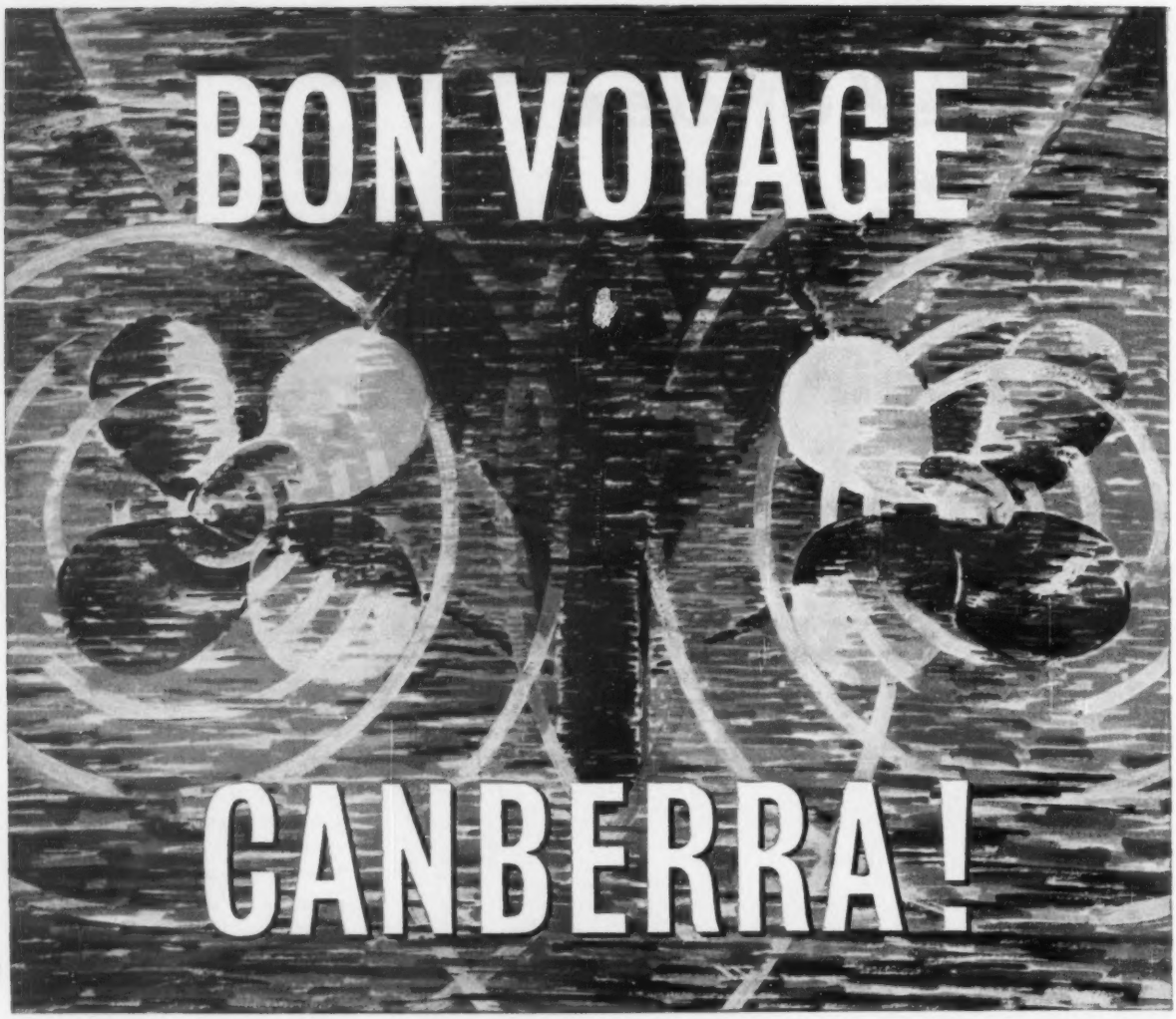
The cross-deck conveyor that handles the baggage moving to and from cabins consists of a group of three interconnected slat conveyors, each based on the Collis SlatVeyor. The centre conveyor is 15ft 6in long and the side conveyors 29ft 6in long. All three are mounted on a gantry which can be traversed along an alleyway extending from one side of the ship to the other. The gantry is carried on rails mounted on the deckhead above, and is driven across the ship by a pinion which engages with a rack on the deckhead. The power for this, and for all other drives, is provided by single-speed squirrel cage motors fed from the ship's 440-volts AC electrical supply.

When it is in the working position the gantry extends through one or other of the side doors, depending on which side of the ship is adjacent to the quay, and one of the side conveyors is wholly outside the ship in the manner shown in the accompanying illustrations. The remaining two conveyors extend across the alleyway at a height of 27in, and the baggage is removed from them by stewards as it passes the baggage elevator. This elevator is installed immediately forward of the conveyors and to starboard of the centreline of the ship, so that a greater length of the conveyor is employed when the ship is loading or discharging through the port side door.



These six sectional views show the cross-deck conveyor (A and B), the baggage room conveyors (C and D), and a typical stores conveyor (E and F), in both stowed and working positions

The conveyors employ a novel design of slat, which provide a travelling surface without gaps. Neoprene inserts in each slat gives good frictional qualities so as to prevent baggage slipping. The slats are carried on roller chains passing over sprockets at each end of the conveyor. The gaps between the centre and side conveyors are bridged by Neoprene rollers which are driven by chains from the main drive shafts, and are thus synchronised with the conveyors.



BP ENERGOL Marine Lubricants have been selected for exclusive use in the new 45,000 ton P & O passenger liner 'Canberra' built at Belfast by Harland and Wolff Ltd. The Power Petroleum Company are sole distributors in Gt. Britain of BP ENERGOL Marine, Industrial and Commercial Transport Lubricants, products of The British Petroleum Company Ltd.

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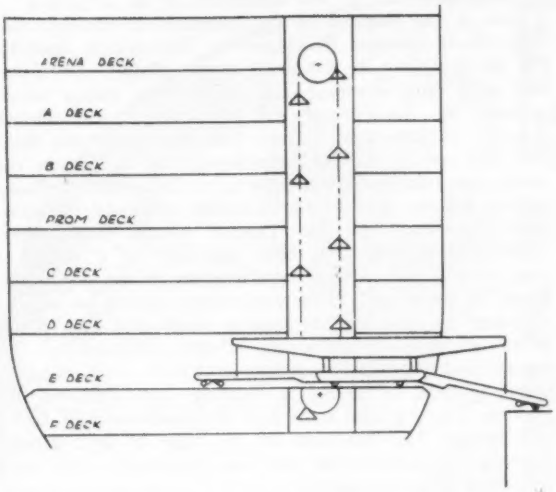


Sketch showing the layout in the ship of the baggage elevator and its associated cross-deck conveyor

The outboard end of the outer conveyor is hung from the end of the gantry by means of two wire ropes operated from a 3-hp winch. When in use it is lowered until a roller comes into contact with the quay, when the upper surface of the conveyor is about 30in from quay level. The equipment is designed to operate satisfactorily with the outboard conveyor at any angle between 15 deg elevation and 30 deg depression. This is sufficient to meet the P & O-Orient requirements for tidal variations and differences in the trim and draught of the ship.

When a ship is secured alongside a quay under tidal conditions it is impossible for her wires to be taut, and she may range a little in a fore and aft direction. This could damage a conveyor extending between ship and shore if it were too rigidly mounted. The design of the Collis conveyors for the *Canberra* has several special safety features to prevent such damage. The two rollers at the end of the conveyor which rest on the quay, one when the conveyor is tilted upwards and the other when it is tilted downwards, are mounted in frames of pantograph type which can accept a certain amount of lateral movement, while the pivots at the inner end are carried in spring-loaded bearers allowing a certain amount of angular movement in a horizontal plane. If the permissible movement at either end is exceeded, a limit switch is operated and the hoist winch raises the conveyor clear of the quay. The operator then stops the winch when the conveyor is clear, and lowers it again when ranging has ceased.

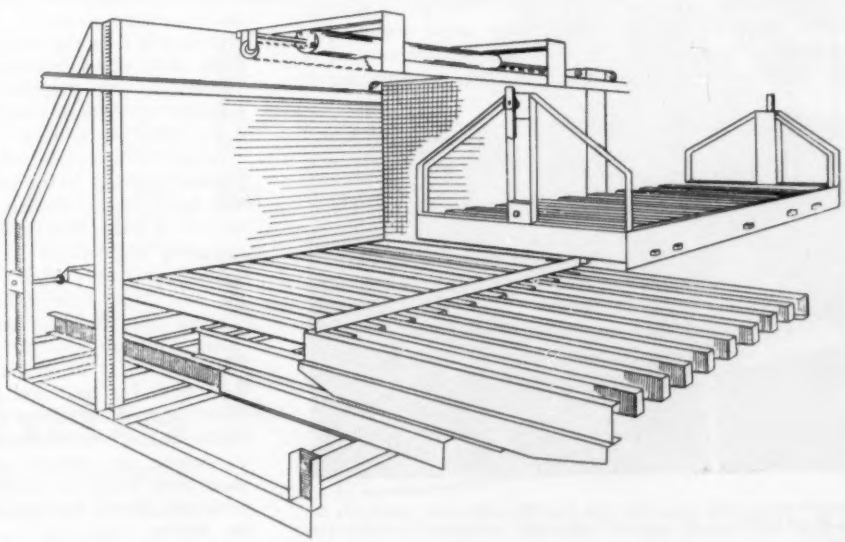
The conveyors are designed to run at a speed of 60ft per minute, with a load capacity of 50 lb per foot run.

When the incoming baggage has been removed from the cross-deck conveyor, it is loaded into the baggage elevator. This is a specially designed version of the Collis VertiVeyor, in which a pair of endless chains run continuously and carry baggage trays spaced at approximately equal intervals. The lift serves five decks—A, B, C, D and E—and passes through the Promenade Deck between B and C Decks, where no service is required. The two chains run over sprocket wheels at the top and bottom of their travel, the upper pair being the drive wheels and the lower pair being used to apply the necessary tension to the chains.

The elevator operates in totally enclosed steel trunking, and at each operating deck there is a loading and a discharge station with automatically-operated fire and smoke-proof doors. At a loading station, the required amount of baggage is placed on the loading table, which is external to the trunking and has a loading gauge to ensure that the maximum size of load that will fit the carrier tray is not exceeded. The operator then presses the selector button for the required discharge deck, and the remainder of the operation is automatic. As the next empty carrier approaches, the fire doors open, the load is moved into the path of the carrier and the fire doors shut again. When the required discharge deck is reached the load is deposited on to a discharge platform which has moved into the elevator. This then withdraws through the fire doors which have been automatically opened, and a pneumatically-operated thruster transfers the baggage from the platform down a chute to the deck.

To achieve this sequence of automatic operations, two main principles are employed. The first is that all working surfaces are in the form of fingers cantilevered out from a crossbar, and arranged so that the fingers of the carrier pass between the fingers of the loading and discharge platforms from which and on to which it picks up and unloads baggage. The other is that all operations are electro-pneumatically controlled, and are initiated by selector bolts on the carriers. These selector bolts run through the fingers of the carriers, and each bolt initiates the operations for one particular discharge deck. The press buttons in the control panel operate selector levers, and the pressing of a button moves the relevant selector lever forward so that it operates the correspond-

(*Continued on page 60*)



Part of the baggage elevator, showing a discharge platform in the extended position, with a carrier tray coming down above it. The pneumatic cylinder shown is the one operating the thruster which pushes the baggage off the discharge platform after the latter has been withdrawn from the elevator shaft

Air Conditioning in the Ship

ONE OF THE LARGEST MARINE INSTALLATIONS

ALL ACCOMMODATION in the *Canberra*, for passengers, officers and crew, is air conditioned. The system is one of the largest marine installations ever designed. The total length of the air ducts is 17½ miles, and the fans move the equivalent of 50,000 tons of air a day—5,000 tons more than the weight of the ship itself.

The system, which was designed, manufactured and installed by Thermotank Ltd, Glasgow, is served by 70 central air conditioning units in which the air is filtered, heated or cooled according to outside conditions, and its humidity adjusted to a comfortable level before being distributed to cabins, public rooms and other accommodation throughout the ship. The central refrigerating plant has a total capacity of 22,000,000 B.T.U. per hour and was manufactured by J. & E. Hall Ltd, Dartford.

Individual Control of Temperature

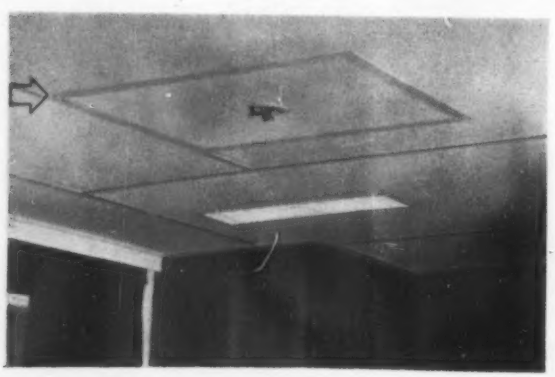
The system provides individual control of the temperature of the conditioned air by means of reheaters. In first class, officers' and engineers' cabins these reheaters are in the branch ducts serving the accommodation. A bulkhead indicator in the cabin itself governs the operation of a thermostat, which in turn actuates the valve controlling the supply of warm water to the reheater. If the passenger sets his indicator to maximum cooling, the valve shuts off the supply of warm water and the conditioned air enters the cabin at the lowest temperature which the system provides. If the passenger subsequently changes the setting of the cabin indicator, the thermostat is brought into operation, allowing the valve to supply warm water to the reheater and thus raising the temperature of the air to suit the passenger's own preference.

The air conditioning units serving the tourist and crew accommodation are fitted with reheaters which operate, for the groups of accommodation they serve, in the same way as the individual cabin reheaters already described, except that the zone thermostats function automatically as a group control. The volume but not the temperature of air entering this accommodation can be controlled at individual cabins, and automatic pressure controllers ensure that the pressure in the system is maintained at the correct level, irrespective of the fluctuating demands thus created.

When heating is required, a calorifier which is fitted in association with the refrigerating machinery supplies warm brine to the air conditioning units, which then function as preheaters. The final temperature control of the conditioned air delivered to the accommodation is again governed by the operation of the reheaters.

One of the features of the system is an entirely new type of air terminal developed by Thermotank specially for the *Canberra*. It is known as the "Sofflo" distributor and is a very compact and unobtrusive fitting which diffuses the conditioned air into the accommodation through a perforated fascia. The distributor fits flush with the ceiling and not only houses the equipment for introducing the conditioned air in a draughtless, diffused pattern but also accommodates, where necessary, the automatic sprinkler and the Tannoy system loudspeaker. Sofflo distributors have been designed in a range of sizes to suit the varying requirements of the accommodation to be served. These distributors had to be accommodated in very shallow ceiling voids and this posed many problems in achieving efficient diffusion of the conditioned air at the unusually low noise level required. Over 14,000ft of Flexflyte ducting (manufactured by Flexible Ducting Ltd) is used in the installation of Sofflo distributors. The flexibility of this type of duct greatly relieved the innumerable problems presented in the very restricted spaces available.

In the public rooms the conditioned air is introduced through "Stripline" grilles. These are continuous strip diffusers which fit flush with the bulkhead.



A cabin ceiling. The arrow indicates the Sofflo distributor, which has the sprinkler in the centre, with air outlet and loudspeaker on either side

INSULATION AGAINST NOISE AND HEAT

INSULATION in a ship can be designed to prevent the transmission either of heat or of sound. In the *Canberra*, extensive use is made of both types. The more novel of the two in ships is sound insulation, and this has been the subject of a good deal of research in the design of the ship. Cabin bulkheads must be thin, to save space, but should prevent as far as possible the transmission of noise from one cabin to another. Before the bulkheads for the ship were designed, research was done for the P & O Company by Acoustical Investigation & Research Organisation Ltd. This work has already been fully publicised. It led to the development of a special cavity bulkhead, mounted on a compound track which insulated the bulkheads from the deck, and this has proved very successful in use.

Insulation against heat is an essential in any ship, and particularly in a passenger ship. There were in fact some six insulation contractors employed during the building of the *Canberra*, and they employed at least eight different insulating materials. One important insulation material used is Caposite moulded asbestos blocks and Rocksil rock wool slabs—materials which are supplied by Cape Insulation and Asbestos Products Ltd. In all, some 550,000 sq ft were used. Another material which has been used on a large scale for this purpose in the *Canberra* is Marinite. About 200,000 sq ft were used, the finishes applied being paint, wood veneers, soft plastic and hard plastic. Marinite has been used for the fire protection of Class A divisions in both steel and aluminium, including engineroom casings, hatch trunking and stairwells. Lightweight Marinite was used in connection with the aluminium superstructure.

Glass fibre has also been used extensively as an insulating material. Fibreglass Ltd supplied a total of over 1,100,000 sq ft of insulation for the ship. It has been used both for heat and for sound insulation in cabins, domestic cold chambers, on air conditioning trunking and in the engine room. Material supplied by this firm is also, of course, an essential constituent of the resin-bonded glass fibre which is widely used in the ship. One of the principal contractors involved in insulation work was the Mersey Insulation Co Ltd.

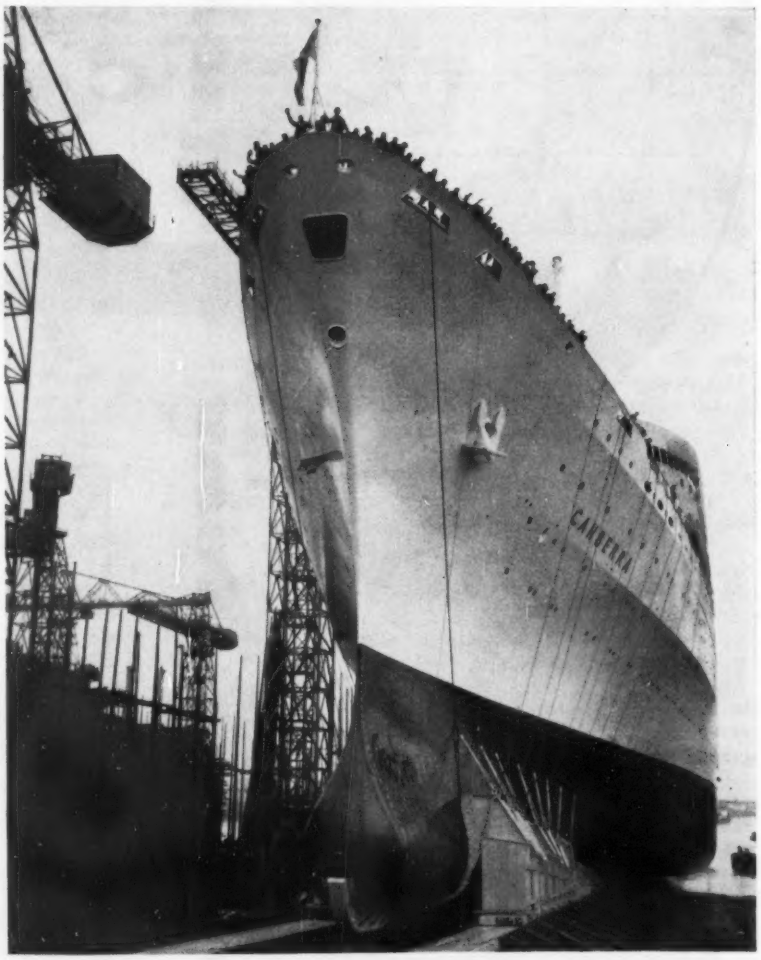
CLARKE CHAPMAN AUXILIARIES

ON P&O ORIENT LINES

CANBERRA

built by Harland & Wolff Ltd., Belfast

- **Anchor cable and warping capstan gear to handle bower anchors and 3.5 8″ steel cable, also driving port and starboard warping capstans.**
  A patent electronic warning device for safe housing of anchors is incorporated.
- **Forward centre line warping capstan.**
- **Aft windlass to handle the stream anchor and 2.1/16″ steel cable driven from aft centre line warping capstan.**
- **Aft port and starboard warping capstans.**
- **Two 3-ton self-contained Ward-Leonard cargo winches.**
- **Two signalling projectors.**



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S 53

MAIN AND AUXILIARY MACHINERY

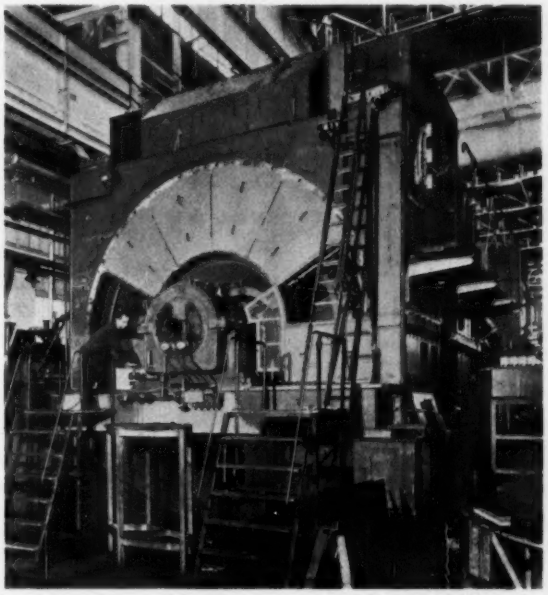
THE *Canberra* is a twin-screw ship, and is unusual among modern passenger liners in having turbo-electric propelling machinery. However this type of machinery has been used in the past, and has given every satisfaction, in a number of large passenger vessels owned by the P & O Company. Its use in the *Canberra* has meant a small penalty in additional weight, space and cost, but no penalty in fuel consumption as there are certain advantageous turbine design features with this arrangement over the direct geared drive. One advantage is the ability to dispense with astern turbines, and reduce the thermal shock experienced by the turbines during manœuvring, thus allowing closer tolerances and less steam wastage. Another advantage is the ability to run the propellers locked together in any given relative phase relationship, so as to produce the minimum vibratory force. The optimum phase relationship for each service speed was determined from a vibration investigation during the trials. This investigation produced a reduction in the amplitude of propeller-excited vibration by a factor of 15 with the optimum setting.

Before the main features of the propelling machinery were chosen, design studies were undertaken on behalf of the company by the Yarrow Admiralty Research Department, and these formed the basis for the final selection of a turbo-electric installation developing 85,000 shp on two propellers. The steam conditions chosen were 750 lb/sq in at the stop valve and 960 deg F temperature, which was considered to be the limit for satisfactory superheater operation with commercially available fuels.

The propelling machinery was constructed by A.E.I. (Rugby) Ltd. The machinery is designed for 68,000 shp at 136.5 propeller rpm in normal service, and 85,000 shp at 147 propeller rpm maximum continuous. Two propulsion turbo-alternator sets normally power independently two double-unit propeller motors.

Excitation requirements for both alternators and propeller motors are met by two propulsion exciters, four of which are available, one driven in tandem with each of four auxiliary 1,500-kW turbo-alternators.

Switchgear permits either of the two double-unit propeller motors, or individual units, to be connected to either propulsion turbo-alternator, as service conditions may demand. Similarly, complete flexibility in choice of excitation source for either propulsion alternator or motor, or motor half unit, is available.



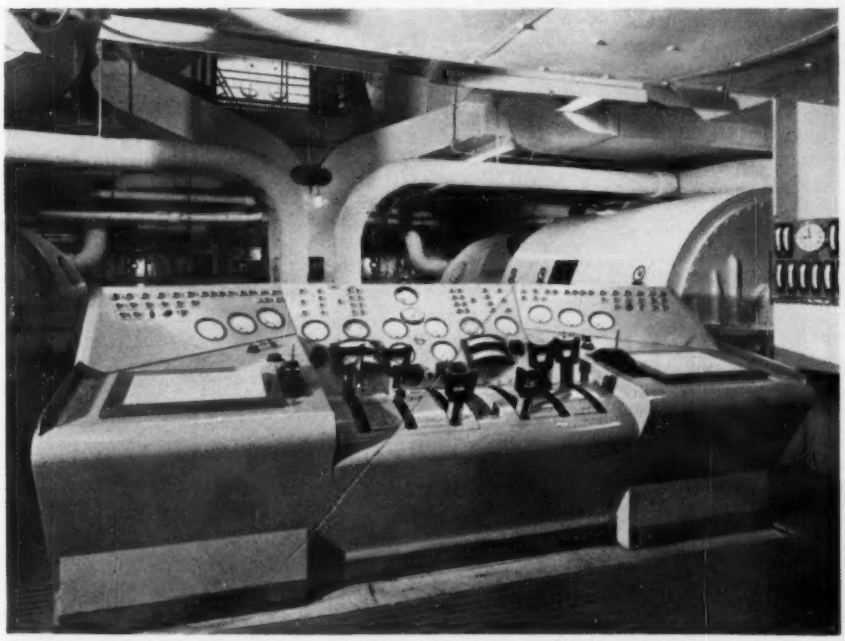
One of the main propulsion motors in the A.E.I. works at Rugby

Apart from emergency running arrangements, the usual combinations are:

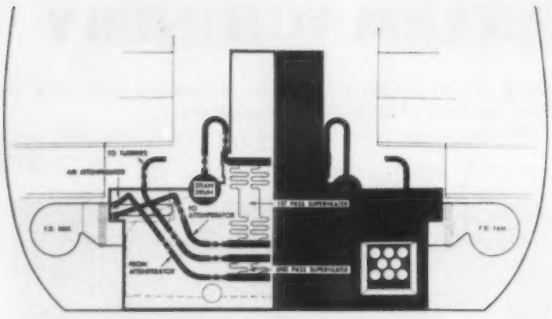
(a) Port turbo-alternator supplying the two port motor units and, independently, the starboard turbo-alternator, supplying the two starboard motor units, up to 85,000 shp.

(b) One turbo-alternator set completely shut down, and the other set supplying both propeller motors at powers up to 40,000 shp. This arrangement allows economical running at reduced powers should the *Canberra* be required for cruising.

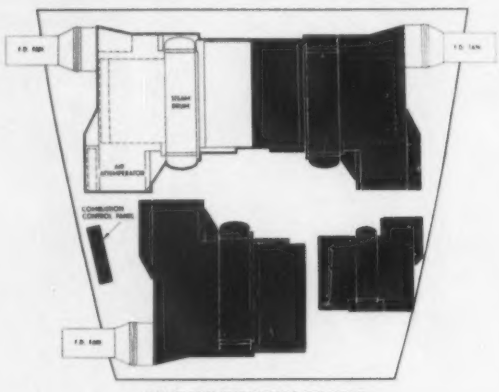
(c) Port and starboard



The main control console, with the two propulsion turbo-alternators behind



ELEVATION OF PORT AND STARBOARD MAIN BOILERS SHOWING STEAM FLOW THROUGH SUPERHEATER AND AIR ATTEMPERATOR



PLAN SHOWING THREE MAIN (E.S.D. TYPE) BOILERS AND ONE AUXILIARY BOILER

Four boilers, three of them the largest yet used in a merchant ship, are fitted neatly into the boiler room. The three main boilers each have a normal output of 175,000 lb/hr and maximum output of 260,000 lb/hr

propellers synchronised. This is attained by the port alternator powering the forward port and starboard propeller motor units, and the starboard alternator powering the two aft propeller motor units.

As has already been mentioned in the preceding paragraphs, the propeller motors are of the double-unit type, i.e. each consists of two machines, completely separate electrically, built into one casing. They are synchronous machines having salient pole rotor with squirrel cage winding in the pole shoes for induction starting and reversing. Each machine has a closed air circuit with electrically-driven ventilating fans and sea-water circulated air coolers mounted on top of the stator frame.

The four propulsion main exciters each have a closed air circuit, excluding the commutator only, with sea-water circulated air cooler mounted in the baseplate. Each develops 300 kW at 300 volts DC.

Propulsion Control Gear and Switchgear

Port and starboard propulsion circuit set-up switches and reversing contactors are contained in cubicles forward of their respective alternators. Amidships is the excitation cubicle containing both port and starboard excitation set-up switches and contactors. Above it, on the turbine platform, is the control console comprising lever gear and instrument panel. Both port and starboard drives have automatic excitation control using a Magnestat regulator which has no moving parts and adjusts the excitation to suit the ship's speed. Each drive has also a standby Magnestat and a hand regulator, with automatic changeover.

The usual instrumentation, and indication and protection circuits, are provided. In addition, an instrument driven by a differential selsyn is fitted to show the relative blade positions of port and starboard screws.

Mechanical interlocking guards against incorrect operation of the propulsion levers, and against access to the control cubicles unless the lever gear is locked in the "off" position.

Main and Auxiliary Boilers

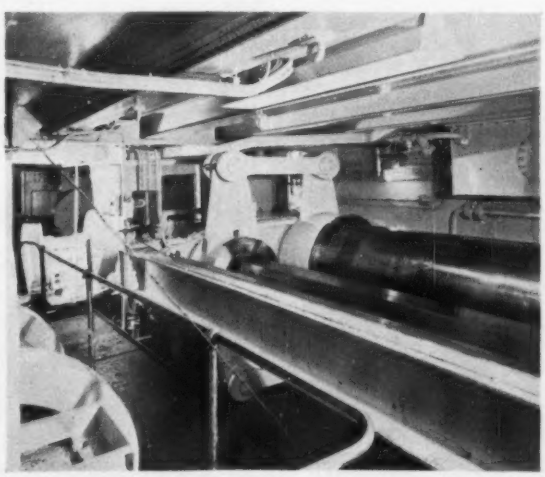
The *Canberra* has three main boilers and one auxiliary boiler, all four being located aft on a boiler flat. They are of Foster Wheeler E.S.D. type. The main boilers are designed with full air casings to suit operation with forced draught only, using steam driven fans, the auxiliary boiler having a forced draught motor driven fan. All four boilers have been built under licence by Harland & Wolff Ltd, the main boilers being the largest marine units built to date, with a normal evaporation of 175,000 lb/hr and maximum evaporation of 260,000 lb/hr.

The Foster Wheeler E.S.D. boiler has the superheater located in the gas flow after the boiler, so that it receives heat by convection. This arrangement was first developed 10 years ago for marine machinery operating at 950 deg F and has proved very successful in minimising superheater maintenance by reducing the working temperature of the tubes and their supports and by eliminating the slagging associated with partly radiant superheaters. Control of the superheat is effected by an air attemperator consisting of extended surface tubing through which the steam flows continuously on its way between the first and second passes of the superheater. Combustion air is used as the cooling medium, and the proportion needed for attemporation is regulated by dampers.

The latest Associated British Combustion suspended-flame type oil burners are arranged for either straight pressure jet or steam-assisted atomisation at will—an arrangement designed to give impeccable burning with wide turn-down, and having compact flames even when burning the 6,500 sec. Redwood fuel for which the pumping and heating units and the oil fuel handling equipment have been designed.

Suspended-flame Burners

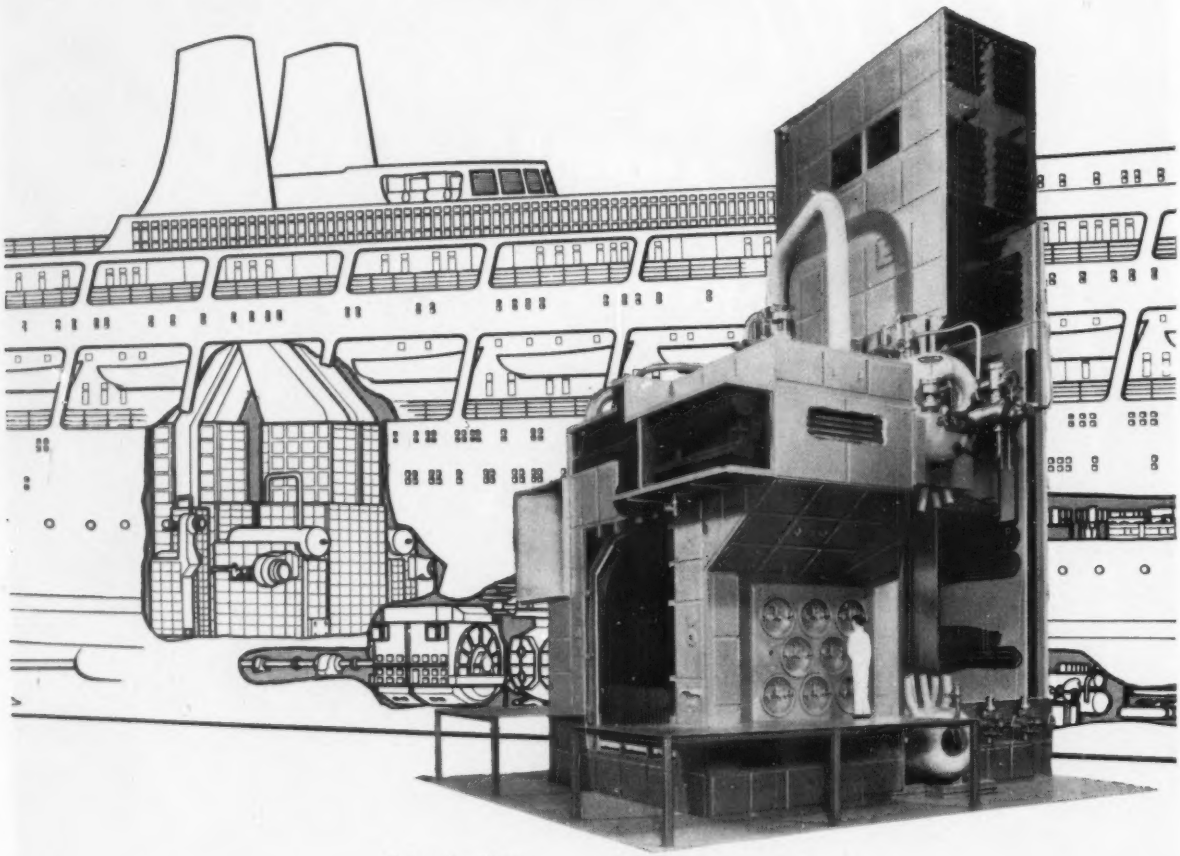
The Foster marine economisers have been built by E. Green & Son Ltd of Wakefield, and consist of a cast iron extended surface and a bare steel section. Sootblowers and fitments for water washing the gas side of the unit are included, with adequate access spaces provided throughout. Bled steam air-heaters are used for pre-



Fin shaft and tilting linkage of one of the Denny-Brown stabiliser units

FOSTER WHEELER
E.S.D. BOILERS SUPPLY THE POWER FOR S.S. 'CANBERRA'

The steam to drive the propelling machinery for this 45,000 ton P & O Orient Liner is provided by 3 Foster Wheeler E.S.D. Boilers. These units are the largest marine boilers built to date and each give the steam conditions shown below. One auxiliary boiler is also fitted.



	Main Boilers	Auxiliary Boiler
Normal evaporation lbs/hr.	175,000	40,000
Maximum evaporation lbs/hr.	260,000	50,000
Steam pressure lbs/sq. in.	750	750
Steam temperature °F	960	900
Feed temperature °F.	240	240

Model of E.S.D. Main Boiler designed for S.S. Canberra.

FOSTER WHEELER LIMITED

FOSTER WHEELER HOUSE, CHAPEL STREET, LONDON NW1. *Telephone: PADdington 1221*

heating the combustion air.

An interesting feature of the main steam pipe installation is the elimination, with a very few exceptions, of all bolted flanges in the external and boiler integral piping, while retaining adequate provision for survey requirements of inspection and testing. Ideas have been taken liberally from current practice in thermal and nuclear power stations.

Propulsion Turbo-alternator Sets

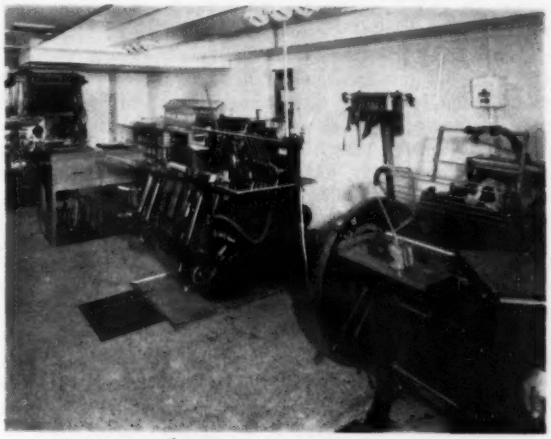
Each propulsion turbo-alternator set is rated at 32,200 kVA, 1.0 p.f., 6,000 volts, 3-phase, 51.5 c/s, 3,100 amperes, 3,087 rpm, equivalent to 85,000 shp on two sets; and 30,700 kVA, 1.0 p.f., 4,670 volts, 3-phase, 40 c/s, 3,800 amperes, 2,400 rpm, when powering both propeller motors at 40,000 shp. The higher currents occur in the cruising condition, and it is therefore this state that determines the alternator size.

Each alternator is driven by a uni-directional single-cylinder turbine with 17 stages and cam-operated multi-valve control. Twin governors are provided. The first holds the turbine speed at 25 per cent full speed during synchronisation of the propeller motor. The second is adjustable from 85 per cent full speed to above the maximum service speed, when it is available as a pre-emergency governor. An emergency governor trips at 10 per cent overspeed.

Distillation Plant

The condensate from the main propelling units passes through a G. & J. Weir system of regenerative feed heating before entering the boilers. The cooling water for the main condensers is supplied by means of scoop circulation with four motor-driven axial flow circulating pumps, two for each unit, as standby. Fresh water for main boilers and ship's use is supplied by a Weir double effect evaporating plant in conjunction with condensate cooled distiller. The sea water distillation plant consists of six vertical evaporator shells, each having a heating surface of 1,050 sq ft. These incorporate the latest Weir patent vapour scrubber, which ensures a distillate of very high purity. The output from the plant is 750 tons a day and this covers all the ship's requirements for domestic laundry and boiler feed purposes. All make-up feed is passed through an Ionostat.

The "Canberra" is equipped with two pairs of Denny-Brown ship stabilisers. This is in contrast to the "Oriana", which has only one set.



In the printing shop. Equipment includes an Intertype printing machine the first to be installed in a British liner

Instrumentation

Very full use has been made of instrumentation in order to ensure the satisfactory operation of the machinery installation. The ship is notable for its use of turbine supervisory equipment, which has been supplied by A.E.I. As with the welded steam piping, this development has been borrowed from power station practice. The equipment records shaft eccentricity, differential expansion and vibration of both main turbines, and also presents the readings on meters at the turbine gauge panel where they can be seen instantly by the engineer on watch.

Immediate warning of boiler feed and domestic water impurity faults is given by electric salinity measuring equipment manufactured by Electronic Switchgear (London) Ltd, of Letchworth, Herts. The three-point indicator unit, or salinometer, has separate circuits and relays for each of the measuring cells. The dial may be switched to show the precise water condition at any cell location without loss of automatic alarm or solenoid valve operation at the point under observation.

Fuel viscosity is measured by the Viscotherm, a viscosimeter of Dutch design marketed in Great Britain by Frank S. Tolliday & Partners, 23 Wormwood Street, London EC2.

Auxiliary Machinery

A.E.I. (Rugby) has also supplied the auxiliary turbo-alternators and the air conditioning turbo-compressor units. The four geared pass-out turbo-alternator sets, each with combined condenser, are individually rated at 1,500 kW, 440 volts, 60 cycles. Steam conditions at the turbine inlet are 700 lb/sq in, 930 deg F. The pass-out pressure is 70 lb/sq in, and quantity 15,000 lb/hr. This "pass-out" steam is used for hotel and auxiliary services. It is more economical to take it in this way than to use a separate steam generator. The alternator has a closed air circuit with two sea-water circulated air-coolers. Voltage control is by a Magnestat automatic voltage regulator. Tandem driven from the alternator is the 300-kW propulsion main exciter.

Two emergency generators are fitted. Each consists of

a 200-kW G.E.C. alternator driven by a 12-cylinder Paxman Vega air-cooled diesel engine, running at 1,800 rpm.

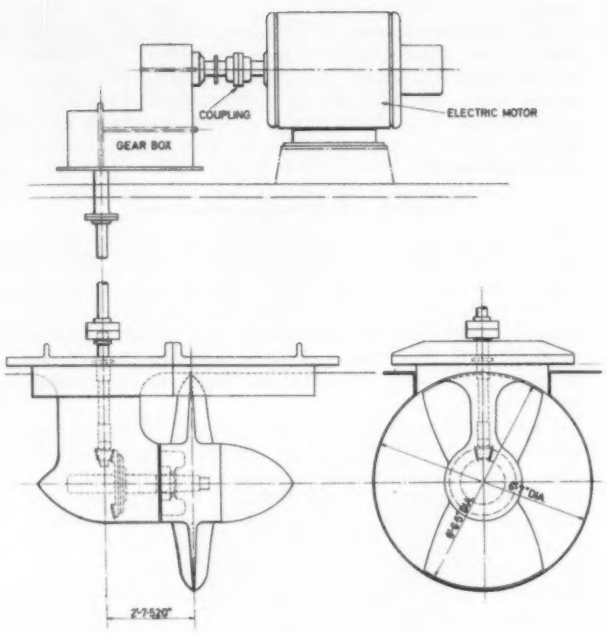
The auxiliary machinery is electrically driven with the exception of the air ejectors and the main turbo feed pumps, one harbour feed pump, the large boiler forced draught fans and the air-conditioning compressors, which are steam turbine driven. Cockburns Ltd supplied valves and boiler mountings, including main and auxiliary boiler stop valves and boiler and economiser feed check isolating valves.

To deal with oily ballast and for stripping, eight Stothert & Pitt screw pumps are installed. The four ballast pumps are of the horizontal positive acting screw displacement type with external bearings. The capacity of each pump, which is motor driven through a Renold chain drive, is 250 tons per hour of oily ballast. The four stripping pumps are of the vertical screw displacement type, also of external bearing design; each is direct coupled to an electric motor, and has a capacity of 75 tons per hour.

Shafting

The twin propeller shafts emerge from the hull about 75ft from their after ends, and are supported in two pairs of A brackets. This technique, normal in warships, is unusual in merchant ships. Its advantage is the cleaner flow of water to the propellers. The shafts are solid, as the expense of boring them would have been prohibitive. For the stern tube glands and those on the aftermost A brackets, Simplex-type oil seal glands are employed, with the shaft running in white metal bearings. These glands are a German development, marketed in Great Britain by Simplex Turbulo Marine Co Ltd. By using oil for lubrication the cost of re-wooding tail-end bearings is eliminated. The intermediate A brackets have Tufnol bearings, allowing salt water lubrication, and this material is also used for the rudder bearings.

The twin propellers are of four-bladed type, and weigh a little under 30 tons each. At service speed they will rotate at about 150 rpm. The working propellers are of the Scimitar design developed by the Manganese Bronze & Brass Co Ltd, and were supplied by this firm. They have been made in Nikalium, a nickel aluminium bronze alloy developed by the company. It is stronger and lighter than manganese bronze, and even more resistant to corrosion. Two spare propellers are carried, and these are of Stone's Heliston design in Novoston alloy, and were manufactured by Bull's Metal & Marine Ltd.



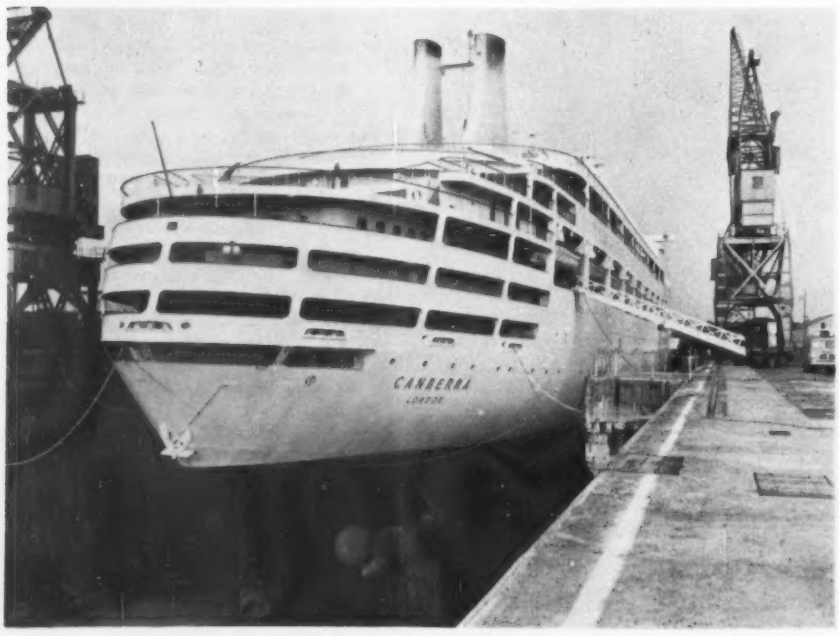
Layout of the Pilgrim bow propeller, showing drive motor and reduction gearing

The propelling machinery is lubricated by BP Energol lubricants supplied by The Power Petroleum Co Ltd.

The Bow Propulsion Unit

Although eclipsed on this point by the *Oriana*, which has transverse propulsion units at both bow and stern and therefore can literally move sideways, the *Canberra* is only the second large liner to have a transverse propulsion unit fitted in her bow. Since with a twin-screw ship the main propellers and rudder can be used to give a good measure of lateral control of the stern of the ship, it is the bow unit that is of primary importance in improving the control of the ship when manœuvring.

The unit consists of an electrically-driven propeller installed in a tunnel running through the ship from side to side 80ft abaft the bows and 20ft below the waterline. The propeller runs in the tunnel with ¼in radial clearances, the tunnel having a diameter of 6ft 7in. The maximum thrust of the propeller is 8.5 tons. The design of the unit is the work of



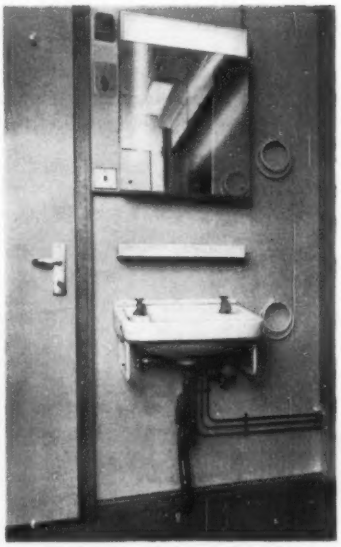
This stern view of the ship in dock shows the propellers, propeller shafts and intermediate A-brackets

S.S. Canberra

has fresh water pipe joints that will not pull-off or work loose

KINGLEY joints were selected for the fresh water installations in S.S. Canberra—already described as "the ship of the century." Kingley joints are also used by H.M. Dockyards for new shipbuilding and refitting, also by many private yards at home and abroad. Kingley are the ideal choice for hot and cold fresh water installations, compressed air and oil feed lines wherever B.S.S. 659 or B.S.S. 1386 tubing is used. Due to the patent swaging principle employed, KINGLEY joints are well able to withstand the stresses and strains to which they are likely to be subjected at sea.

A standard range of over 240 deck and bulkhead fittings is available, backed by a first-class delivery service.



A bathroom in S.S. Canberra for which Kingley fittings were used, is shown by kind permission of P. & O.-ORIENT LINES and HARLAND & WOLFF LTD.

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In the cinema projector room. The cinema seats 332 people, and serves both classes

Mr T. W. Bunyan, engineer adviser to the P & O Company, and it was made by Brown Brothers & Co Ltd, Edinburgh, the firm that also made the steering gear for the ship. As with other designs of equipment owned by P & O Research & Development Co Ltd, of which Mr Bunyan is managing director, the bow propulsion unit has been given the name Pilgrim—a pun on the identity of Mr Bunyan's name with that of the author of *Pilgrim's Progress*.

The bow propeller in the *Canberra* is driven by a Harland & Wolff 3,300-volts three-phase electric motor. The motor is of the uni-directional slipring type, giving speed variation, and drives the vertical shaft through a Hindmarch/MWD reversing gear. Controls are provided to give four speeds in either direction. The bevel gears in the propeller boss are oil-lubricated, and a Simplex stern tube seal is used to prevent leakage.

SPECIAL TYPEFACE DESIGNED

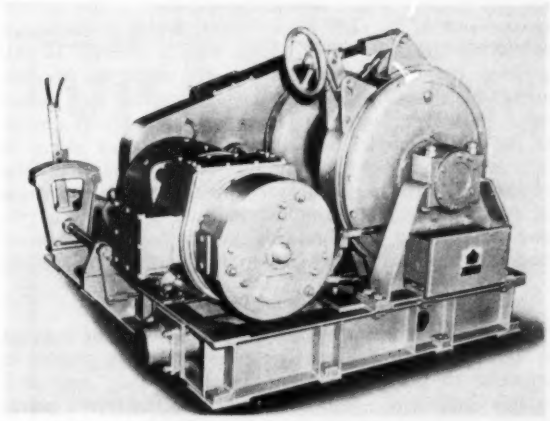
A SPECIAL *Canberra* typeface has been evolved for the notices and signs throughout the ship. The designer is Edward Burrett. The fount is a medium-weight sans-serif titling letter of simplicity, and designed to be legible in all sizes from ¼in to 5ft deep (the size of the name on the bows of the ship). Apart from legibility, a sans-serif type is also especially suited for manufacture in plastic, wood, metal and glass. The typeface will be used as a heading in "*Canberra* News", the daily newspaper printed on board.

The ship's printing department has the first Intertype machine ever to be installed in a British liner. There is also a proofing press and a new platen machine. The print shop will be able to produce any printed matter required, such as menus, of which there will be three per day in the two classes (first and tourist), tickets for entertainments and programmes, or announcements. The typeface chosen is Times Roman for keyboard setting, complemented by founders' type in case.

CARGO HOLDS AND DECK MACHINERY

THE *Canberra* has three holds, all forward in the ship, with a total capacity of about 150,000 cu ft. No 1 hold is served by a hatchway in the normal fashion, with two streamlined derrick posts carrying derricks worked by electric winches which were supplied by Clarke, Chapman & Co Ltd. The two aftermost holds are situated below accommodation, and these are worked through side ports which avoid the necessity for hatches. Cargo for these holds is handled by two Carron cargo transporters. Each of these is capable of operating on either side of the ship, and requires only one operator. Each transporter consists of a structural steel boom, carried on rollers within the ship and capable of being power-driven to project through doors in the ship's side. The boom is housed within the ship when not in use, and can project on either side to suit the docking arrangements. On the boom, which extends some 30ft from the side of the ship in the operating position, there is a travelling carriage from which is suspended a hoist with a cargo platform. An operator, seated in a cab on the carriage, controls the traversing, hoisting and lowering of the cargo platform. The equipment represents a development of an idea which originated in America, and the *Canberra* is the first British ship to have it. The two aftermost holds and tweendecks are arranged for the carriage of 50 to 100 cars, dependent on size.

Other deck machinery includes a windlass and capstans supplied by Clarke, Chapman & Co Ltd, and two Pitt-Scott automatic tensioning winches. These latter are manufactured by Stothert & Pitt Ltd, with electrical equipment by Laurence, Scott & Electromotors Ltd. The winches



One of the Pitt-Scott winches supplied to the ship

supplied have a range of 2,500 to 15,000 lb pull in automatic control and up to 20,000 lb in manual control. The control quadrant has six tension notches and a neutral notch. Each step corresponds to an increase of 2,500 lb pull, and the winch corrects the tension when it varies by more than 500 lb from the selected value.

The electro-hydraulic steering gear was manufactured by Brown Brothers & Co Ltd, Edinburgh. It is of the four cylinder Rapson slide type, having two power units each consisting of a 275-bhp electric motor driving a VSG variable delivery pump. Each power unit is capable of full duty, the other being a standby. The steering gear is arranged so that five combinations of hydraulic cylinders can be used—all four, two port, two starboard, two forward or two aft.

MECHANISED BAGGAGE HANDLING

(*Continued from page 47*)

ing selector bolt on the carrier as the latter goes by. This bolt has now been pushed in at one end and therefore protrudes at the other end, where it strikes a series of switches as the carrier approaches and passes the discharge deck required, thus initiating the various operations in their correct sequence. As the tray passes round the bottom sprocket after discharging its load, a striker plate resets all the selector bolts, and sets one which indicates that the carrier is empty and will initiate loading operations at any deck where a button has been pressed. The various operations are carried out by pneumatic cylinders and these are controlled by electric solenoids which in turn are operated by the switches.

The carrier trays consist of a flat base composed of fingers, as already described, carried by two side brackets. At their upper ends the brackets terminate in pivots which are attached to the chains. Between the sprocket wheels the chains run in channel guides, and spigots protruding from the base of each carrier at either side also engage in these guides, and so prevent any tilting of the trays if they are unevenly loaded with baggage.

The trays are loaded as they go up and discharged as they descend, and so pass over the upper sprockets loaded with baggage. The channel guides must of necessity terminate short of the sprockets, and some device is therefore needed to ensure that the trays remain upright as they pass over the top sprocket, both to avoid any chance of baggage falling off at this point and to ensure that the tray spigots re-engage in the channel guides on the descending side.

The device used is called a stabiliser. It consists of a small trolley running between rails above the upper sprocket wheels, and carrying short vertical sections of channel guide. When at rest the stabiliser trolley is held at one end of its rails by a weight, which is connected to the trolley by a wire passing over a pulley. In this position the trolley guides marry up with the channel guides on the ascending side. As a carrier tray comes up to the upper sprockets its pivots and spigots engage in the trolley guides, and it draws the trolley along its rails while the trolley maintains the carrier in a vertical position. As the carrier tray begins to descend it engages in the channel guides on the descending side, and the stabiliser trolley then returns to its original position, ready for the next carrier, under the action of the weight.

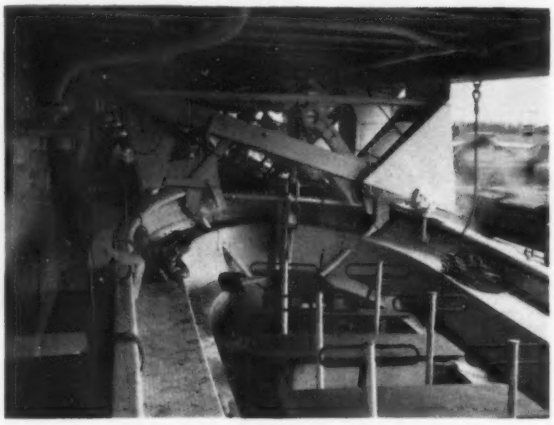
Baggage Room Conveyors

The conveyor arrangements for the handling of baggage to and from the baggage room are generally similar in principle to the cross-deck conveyor already described. In this case there are two swan-necked conveyors permanently installed between the side doors to port and starboard and the baggage room on the deck below (F Deck), while a gantry that can be traversed along an alleyway extending across E deck carries two conveyors, one at either end, one or other of which provides the link between side door and quay. The outboard end of these conveyors is lowered by two wire ropes, as with the cross-deck conveyor.

The stores conveyors are simpler than those for baggage, each unit consisting of a single slat conveyor. In the case of the three permanently installed units, this conveyor is carried by a gantry which runs outboard, and lowers the conveyor into position between side door and quay by means of wire ropes and lead screws. The fourth conveyor, which is portable and can be used to replace any of the other three if necessary, has no gantry and must be specially rigged in whichever position it is to be used.

Lifeboats and Davits

BECAUSE of the *Canberra's* size, P & O-Orient Lines felt that considerable advantages could be obtained by placing the lifeboats nearer the waterline instead of on the top deck as is normal. By placing them three decks lower down, an added safety factor is introduced, since the distance the boats will have to be lowered in the case of emergency is reduced. Furthermore, by stowing them within the ship's breadth, flush with the ship's side, a streamlined effect—in keeping with the ship's general appearance—has been produced. The arrangement has the added advantage of leaving the entire space of the top deck free for passengers' enjoyment. All the boats are stowed under "A" Deck.



One of the Welin-MacLachlan gravity-type davits, specially designed for the "Oriana" and "Canberra"

The lifeboats themselves are made of glass fibre, and material for this and other purposes was supplied by Fibreglass Ltd. As in *Oriana*, which has a similar arrangement of boats, the lifeboats are operated from specially-designed Welin-MacLachlan gravity-type davits. Viking Marine Ltd built the 24 lifeboats for the *Canberra*. These comprise six 36ft motorboats and 16 hand-propelled boats. In addition, there are two 26 ft specially-designed rescue lifeboats, which are almost self-righting.

One of the rescue lifeboats. They have air-cooled diesel engines which can be warmed up before the boat enters the water

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THE VESSEL is fitted with the Toxion anti-fouling system for the prevention of marine growth on the underwater hull.

THE Tyfon steam whistle has electric operating gear, and a Secomak all-electric whistle is also provided.

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